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CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. VIII.

GENUS *Aedes*, SUBGENUS *Mucidus* THEOBALD

IN SOUTHEAST ASIA<sup>1</sup>

By

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INTRODUCTION

The subgenus *Mucidus* was originally described by Theobald (1901b: 268) as a distinct genus based on *Culex alternans* Westwood. Theobald (1907: 280) erected a new genus *Pardomyia* in which he described the species *aurantius*. The following year Leicester (1908: 71) described the same species placing it in his new genus *Ekrinomyia* and called it *aureostriata*. Edwards (1932: 133) placed the above three genera into the subgenus *Mucidus* of the genus *Aedes*. He then divided the subgenus into two groups, Group A *Mucidus* and Group B *Pardomyia*, which are differentiated on page 30. Although various authors have disagreed on the speciation within the groups, Edwards' higher classification has remained unchallenged.

This paper deals with six species from Southeast Asia in which the range of one is enlarged and the hitherto unknown immature forms of *Ae. laniger* (Wiedemann) are described. Keys to the adult, pupal and larval forms of species found in Southeast Asia are included. The key to the adult forms also includes all recognized species and subspecies of the subgenus. For taxonomic information on the Australasian forms see Knight (1947) and Belkin (1962). For the Ethiopian forms see Edwards (1941), Gebert (1948), Hopkins (1952), Muspratt (1959), and Tyson (1970). For additional information on Indomalayan and Philippine *Mucidus* see Knight & Hull (1951) and Mattingly (1961).

Abbreviations used in references to literature conform to the World List of Scientific Periodicals, 3rd. ed., Academic Press, New York, 1952. An asterisk following the abbreviations used (♀ = female, ♂ = male, P = pupa, L = larva) indicates that at least some portion of that form is figured. New distribution records are indicated by two asterisks.

Specimens of the following species of *Aedes* (*Mucidus*) have been examined during the course of this study: *alternans* (Westwood), *aurantius* *aurantius* (Theobald), *aurantius chrysogaster* (Taylor), *ferinus* Knight, *grahamii* (Theobald), *laniger* (Wiedemann), *lucianus* Muspratt, *mucidus* (Karsch), *nigerrimus* (Theobald), *painei* Knight, *quadripunctis* (Ludlow), *quasiferinus* Mattingly, *scatophagoides* (Theobald), *sudanensis* (Theobald), and *tonkingi* Gebert.

There is a great diversity exhibited between the two groups, *Mucidus* (Group A) and *Pardomyia* (Group B), and the following list (although incomplete) was derived to show a spectrum of the major differences that exist.

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## GROUP A MUCIDUS

## GROUP B PARDOMYIA

## ADULTS

- |  |   |
|--|---|
| 1. Scutum with decumbent scales and tufts of twisted, erect scales.                            | 1. Scutum with decumbent scales only.                                   |
| 2. Body color white, yellow, and brown.  | 2. Body color yellow-gold and brown.                                    |
| 3. Wings with large scales of white, yellow and brown.   | 3. Wings with smaller scales of yellow and brown.                       |
| 4. Abdomen light with apical segments white and yellow with some scales erect.                 | 4. Abdomen dark with apical segments yellow-gold, all scales depressed. |
| 5. Lower mesepimeral bristles 3-8.   | 5. These bristles 0-5.  |
| 6. Palpi of female long, 0.8 length of the proboscis.  | 6. Palpi of female shorter, 0.25 length of the proboscis.               |
| 7. Thoracic pleuron with many white scales, some erect.  | 7. Thoracic pleuron with small patches of decumbent yellow scales.      |
| 8. Legs with many erect scales.  | 8. Legs with decumbent scales only.                                     |
| 9. Males with palpi longer than proboscis by one segment.                                      | 9. Males with palpi only slightly longer than proboscis.                |
| 10. Fore and mid tarsal claws of male toothed, major claw with two teeth, minor claw with one. | 10. Male with major tarsal claw with one tooth, minor claw simple.      |

## PUPAE

- |   |                                     |
|---|-------------------------------------|
| 1. Trumpets moderate in length and wide.    | 1. Trumpets very long and narrow.   |
| 2. Cephalothorax with hairs single.         | 2. These hairs multiple.            |
| 3. Abdominal hair 1-I with branches simple. | 3. This hair with plumose branches. |

## LARVAE

- |  |  |
|--|--|
| 1. Siphon with pecten not attaining siphonal tuft. | 1. Siphon with pecten attaining siphonal tuft.   |
| 2. Siphonal tuft not plumose.                      | 2. Siphonal tuft plumose.                        |
| 3. Head hair 1-C long and slender.                 | 3. This hair small, thorn-like.                  |
| 4. Abdominal hair 2-VIII single.                   | 4. This hair double.                             |
| 5. Antennal tuft of 2-3 hairs.                     | 5. Antennal tuft of 3-5 hairs.                   |
| 6. Thoracic hairs 8-P, 9-M, and 9-T single.        | 6. These hairs multiple or multiple and plumose. |

7. Saddle with dorsal, apical region with numerous small spines.      7. Saddle apex smooth.

The general characteristics of the subgenus were categorized by Knight (1947: 315) and more completely by Mattingly (1961: 18). The following combination of characters are those which generally separate this subgenus from other *Aedes*. Wing membrane clouded in the region of the cross veins; posterior pronotal bristles numerous (10-30); anterior and medial mesepimeral bristles present or absent (= lower mesepimerals of Knight, Mattingly, and others); female with cerci long and narrow; male with palpi as long as or longer than proboscis; larvae with mouth parts modified for predation; anal segment with ventral brush extending the length of the segment; pupae with large paddles.

GENUS *Aedes* MEIGEN  
SUBGENUS *MUCIDUS* THEOBALD

*Mucidus* Theobald 1901a, J. trop. Med. 4:235. Logotype: *Culex alternans* Westwood, (Neveu-Lemaire) 1902, 219.

*Pardomyia* Theobald 1907, Mon. Cul. 4: 280. Haplo type: *aurantia* Theobald.

*Erkinomyia* Leicester 1908, Cul. Malaya :65, 71. Haplo type: *aureostriata* Leicester.

*Aedes (Mucidus)* Theobald, Edwards 1932, Gen. Insect., Fasc. 194: 132; Knight 1947, J. Wash. Acad. Sci. 37: 315; Hopkins 1952, Mosq. Ethiopian Region, 1: 121; Mattingly 1961, Cul. Mosq. Indomalayan Area, V: 17.

**FEMALE.** *Head.* Torus and flagellomere I with a mesal patch of scales (flagellomere scales few or absent in Group B); palpus 0.25 (Group B) to 0.8 (Group A) length of proboscis; palpus and base of proboscis with large erect scales (Group A) or moderate depressed scales (Group B); orbital and frontal bristles well developed; orbits margined with pale scales (whitish, Group A; yellow, Group B); scales of vertex mostly erect with apices forked; narrow decumbent scales on vertex present. *Thorax.* Scutum with scales narrow, decumbent (Group B) or decumbent with paired erect tufts (Group A) usually located in the following regions: scutellar, supraalar, posterior, dorsocentral, and fossal; scutum with bristles well developed, long; anterior promontary, humeral, acrostichal, dorsocentral, ante- and supraalar, and prescutellar bristles always present; scutellar bristles long; postnotum bare; anterior pronotal lobes widely separated, erect, with numerous scales and well developed bristles; pleura with several large patches of scales, some of which are erect (Group A) or decumbent and reduced to smaller patches (Group B); scales on the propleuron, sternopleuron, upper and lower mesepimeron, upper and lower prealar, and paratergite are common to both groups; bristles are present on the posterior pronotum, postspiracular, prealar, propleuron, sternopleuron, and mesepimeron; meron, metameron and metapleuron bare; middle or middle and anterior mesepimerals present, large (Group A) or moderate and few to absent (Group B). *Legs.* Fore, mid and hind coxae and trochanters with patches of scales and bristles; femora and tibiae with some erect scales (Group A) or mostly depressed scales (Group B) and distinct bands of white and brown (Group A) or yellow-gold and brown (Group B); fore and mid tarsomeres variable, dark scaled above, yellow beneath with basal yellow bands (Group B) or unicolorous yellow (Group A), or yellow with white basal bands on I and II (*tonkingi*) or with basal white bands on I-III and a median band on I (*scatophagoides*, *alternans*); hind tarsomeres dark brown with narrow yellow bands on I-III, sometimes on IV, with V all white (Group B) or with

segments yellow or yellow-brown with basal white bands on all tarsomeres or with IV and V all white (Group A) or with II all yellow-brown (*laniger*). *Wing*. Usually light and dark scaled with small to large scales, small scales yellow and brown (Group B) or with large white, yellow and brown scales (Group A); alula with narrow dark or dark-tipped scales confined to the fringe; squama with a fringe of long hairs; membrane in regions of the cross veins always clouded. *Halter*. With pale scales (Group A) or darker scales mostly on the apical half (Group B). *Abdomen*. Scaling of terga variable but generally with the basal half dark (Group B) without white scales or erect tufts or generally light with many white scales and some erect, lateral tufts (Group A). *Terminalia*. Cerci long and narrow; postgenital plate emerginate or truncate; three spermathecae, one usually larger than the others.

**MALE.** Similar to the female in general habitus. *Head*. Antenna plumose with hairs directed primarily dorsally and ventrally; palpus slightly longer than the proboscis (Group B) or much longer (Group A), penultimate segment shorter than last segment (Group A) or equal to or longer than the last segment (Group B), both with many ventral hairs; apex of segment III also hairy ventrally; apical segment with long, laterally projecting hairs with fewer on dorsoventral aspects (Group A) or with a moderate number of shorter hairs mesally (Group B). *Legs*. Fore and mid tarsal claws unequal, minor claw approximately 0.5 length of major claw and with one tooth, major claw with two teeth (Group A) or with minor claw entire and major claw with one tooth (Group B); hind claws equal, simple or with a minute denticle (Group B) or with one tooth (Group A). *Wing*. Similar to female but scales reduced in size and number and generally paler in color. *Terminalia*. Distimere slender with 2 to 4 setae on outer, apical 0.25, and with a well developed slender appendage; basimere with basal lobe only; basal lobe with 1-5 strong setae at base as well as numerous slender bristles (Group A) or with only bristles (Group B); claspette stem with several moderate bristles along its length (Group B) or without such bristles (Group A), filament well developed; phallosome (aedeagus) usually without teeth though in *scatophagoides* and *tonkingi* the aedeagus has a median raised ridge or carina which in *scatophagoides* projects beyond the apex in the form of a tooth.

**PUPA.** The pupae can be divided into their appropriate groups by the characters given on page 30. The great variation within this subgenus is exemplified in this immature form. The number and size of many of the body hairs are extremely variable and atypical members of related species are not easily separated.

**LARVA.** *Head*. Antenna spiculate with the antennal tuft of 2-3 hairs (Group A) or of 3-5 hairs (Group B); hair 1-C long and slender (Group A) or short and thorn-like (Group B); hair 9, 10-C single or double (Group A) or multiple (Group B); mouth brushes elongate, serrate on the inner apical margin; mental plate with 13-15 teeth; mandible trifold, basal tooth usually with 4 blunt lateral teeth. *Thorax*. Mesothoracic hairs 8, 9-M multiple and plumose (Group B) or 8 multiple not plumose and 9 single (Group A); metathoracic hairs 7, 9-T multiple and plumose (Group B) or 7 multiple, not plumose, and 9 single (Group A). *Abdomen*. Segment VIII with comb patch of 30 to 80 scales (usually over 50) in several rows, scales fringed on apical half, variable in size and shape and in number in each individual; hair 2-VIII single (Group A) or double (Group B); hairs 1, 3, 5-VIII plumose (Group B) or simple (Group A); siphon moderate with siphonal tuft (1-S) near middle and of 4-15 branches, plumose (Group B) or simple (Group A); pecten reaching or surpassing siphonal tuft (Group B) or not (Group A); pecten teeth variable, entire or having 1-4 lateral teeth; anal segment with saddle incomplete with dorsal apical edge smooth (Group B) or with many small spines (Group A); ventral brush covering the complete length of the anal segment; hairs 2, 3-X extremely long; anal papillae short, usually less than the length of the saddle.

DISTRIBUTION. The following is a list of the recognized species of *Aedes (Mucidus)* arranged by zoogeographical regions.

#### AUSTRALASIAN REGION

1. *Aedes (Mucidus) alternans* (Westwood)
2. *Aedes (Mucidus) aurantius chrysogaster* (Taylor)
3. *Aedes (Mucidus) painei* Knight

#### ORIENTAL REGION

1. *Aedes (Mucidus) aurantius aurantius* (Theobald)
2. *Aedes (Mucidus) ferinus* Knight
3. *Aedes (Mucidus) laniger* (Wiedemann)
4. *Aedes (Mucidus) quadripunctis* (Ludlow)
5. *Aedes (Mucidus) quasiferinus* Mattingly
6. *Aedes (Mucidus) scatophagoides* (Theobald)

#### ETHIOPIAN REGION

1. *Aedes (Mucidus) grahamii* (Theobald)
2. *Aedes (Mucidus) lucianus* Muspratt
3. *Aedes (Mucidus) mucidus* (Karsch)
4. *Aedes (Mucidus) nigerrimus* (Theobald)
5. *Aedes (Mucidus) sudanensis* (Theobald)
6. *Aedes (Mucidus) tonkingi* Gebert

The two groups have overlapping ranges. Group B is recorded from EAST and WEST MALAYSIA, NEW GUINEA, PHILIPPINES, AUSTRALIA, SOLOMON ISLANDS, BISMARCK ARCHIPELAGO, and INDONESIA (see map #2). The range of Group A can be divided into two distinct areas. The first (Oriental-Australasian) ranges from WEST PAKISTAN, INDIA, CEYLON, BURMA, THAILAND, SOUTH VIETNAM, and MALAYSIA, south and west to INDONESIA, NEW GUINEA, PHILIPPINES, TIMOR, NEW CALEDONIA, and AUSTRALIA (map #1). The second area is Ethiopian and *Mucidus* has been collected in the following countries: GHANA, KENYA, MALAWI, MALI, MAURITANIA, MOZAMBIQUE, NIGERIA, REPUBLIC OF SOUTH AFRICA, RHODESIA, SENEGAL, SOMALIA, SUDAN, TANZANIA, THE DEMOCRATIC REPUBLIC OF THE CONGO, UPPER VOLTA, and ZAMBIA. The presence of *tonkingi* on Mauritius presents an interesting problem. The absence of *Mucidus* on Madagascar and the Islands of the Seychelles-Mauritius Ridge limits the possibility of it radiating from Africa. Its close relationship to the African *sudanensis*, the Oriental *scatophagoides*, and the Australasian *alternans* further complicates the issue. Many major problems need to be answered before the origin and routes of distribution of the groups can be hypothesized.

**BIOLOGY AND MEDICAL IMPORTANCE.** Although not shown to be a vector of human pathogens, several species do not hesitate to feed on man. *Aedes laniger*, *scatophagoides*, *alternans*, and *aurantius* are recorded as feeding on man. The type series of *scatophagoides* was collected feeding on patients in a hospital in India (Giles in Theobald 1901b: 278).

Adults are apparently arboreal (Mattingly 1949: 399) and nocturnal (Haddow *et al.* 1951: 217). Knight (1947: 321) records *alternans* as a vicious biter and feeding at sundown. The majority of authors agree that *Aedes (Mucidus)* breed only in temporary pools of various types, and the larvae feed on other mosquito larvae. Hopkins (1952: 122) records *mucidus* larvae as showing no reluctance to feeding on smaller specimens of its own species. Gebert (1948: 96) records *tonkingi* in association with *Anopheles gambiae* and *Aedes fowleri*. Rageau & Hamon (1957: 377) record the prey of *alternans* as

being *Aedes vexans*, *vigilax*, *Culex sitiens* and *annulirostris*. Paine & Edwards (1929: 305) record *painei* feeding on *Aedes funereus*, *Culex hilli*, and *Anopheles punctulatus*. Edwards & Given (1928: 341) found *aurantius* in association with *Aedes umbrosus* and Bick (1951: 406) found *aurantius chrysogaster* in association with *Culex pullus*, *halifaxii*, *Anopheles punctulatus*, and *Uranotaenia argyrotarsis*.

Hopkins (1952: 113) believes that because of a lack of succession of generations in breeding places, the eggs are probably deposited at random while flying. Bancroft (in Theobald 1907: 162) and Giles (in Theobald 1901b: 279) note the eggs being laid singly, and Hopkins (1952: 121) believes them to be resistant to dessication.

Although fresh water is primarily utilized, *alternans* is said to breed successfully in saline marshes (Knight 1947: 321). Other species have been collected in highly polluted waters (Bick 1951: 406) or water free from pollutants.

#### KEY TO THE WORLD SPECIES OF ADULT *MUCIDUS*

1. Scutum with tufts of twisted erect white scales; general coloration white, yellow, and brown; palpi of female over 0.5 as long as proboscis ..... Group A, *Mucidus* ..... 2
- Scutum with scales depressed; general coloration gold and brown; palpi of female barely 0.25 as long as proboscis ..... Group B, *Pardomyia* ..... 12
- 2(1). Distal white band on all tibiae subapical; (Fig. 6); Australasian ..... *alternans*
- Distal white band on all tibiae apical; Ethiopian and Oriental ..... 3
- 3(2). Fore tibia with apical white band not occupying more than 0.25 of total tibial length, usually with a median white band (sometimes restricted to a few white scales) ..... 4
- Fore tibia with apical white band longer than 0.25 of total tibial length, or median band of fore tibia absent ..... 7
- 4(3). Tarsomere I of all legs with a distinct basal and medial white band; fore and mid tarsomeres II, III (often IV, V) with basal white bands; Ethiopian and Oriental ..... 5
- Tarsomeres not as above ..... 6
- 5(4). Proboscis with many white scales at middle (reduced to a vaguely defined ring in male); Oriental ..... *scatophagoides* (p. 43 )
- Proboscis yellow scaled, without white scales at middle; Ethiopian ..... *sudanensis*
- 6(4). Fore tibia with a well developed median pale band; Philippines ..... *ferinus* (p. 37 )
- Fore tibia with a vague or interrupted (sometimes absent) median pale band; Indomalayan ..... *quasiferinus* (p. 41 )

- 7(3). Hind tarsomere II brown, sometimes with a few scattered white scales along its length; Oriental ..... *laniger* (p. 39 )
- Hind tarsomere II with a distinct basal white band; Ethiopian ..... 8
- 8(7). Hind tarsomere III 0.3-0.6 white basally; costa largely yellow ..... 9
- Hind tarsomere III white except at tip; costa yellow but generally darker ..... 10
- 9(8). Fore tarsomeres I, II and mid tarsomeres I-III with a pale basal band; Mauritius ..... *tonkingi*
- Fore and usually mid tarsomeres unicolorous; (Fig. 5); Africa ..... *mucidus*
- 10(9). Costa and apical 0.33 of R<sub>1</sub> mostly yellow scaled; proboscis yellow and white scaled, few, if any, dark scales present beyond basal 0.33; general color yellowish; Southeast Africa ..... *lucianus*
- Costa darker, usually with basal 0.5 very dark; scales of proboscis mostly dark with dark scales usually reaching apex; general color much darker; Central Africa ..... 11
- 11(8). Hind tarsomere II less than half white, hind tarsomeres IV, V mostly white ..... *nigerrimus*
- Hind tarsomere II more than half white; hind tarsomeres IV, V either yellow-brown or mostly white (Fig. 6) ..... *grahamii*
- 12(1). Scutum entirely yellow-copper scaled or with a few scattered dark scales randomly placed; medial and anterior mesepimeral bristles usually absent; integument reddish-brown; Philippines ..... *quadripunctis* (p. 49 )
- Scutum with considerable areas of brown scaling; medial and anterior mesepimeral bristles combined 1-5, integument brown ..... 13
- 13(12). Females only.<sup>1</sup> Scutum with basal and apical yellow scale bands, medial region with dark brown scales (a few yellow scales may sometimes be present) ..... 14
- Scutum as above but medial region with many yellow scales, as many as the dark scales; Australia and New Guinea ..... *aurantius chrysogaster*
- 14(13). Terminal abdominal terga V-VIII entirely yellow scaled; Malaya to New Guinea ..... *aurantius aurantius* (p. 46 )
- Abdominal terga VI-VIII with yellow scaling largely confined to mediodorsal area with many dark scales intermixed; Solomon Islands ..... *painei*

<sup>1</sup>Males of the *aurantius* complex, including *painei*, are indistinguishable.



KEY TO THE PUPAE OF SOUTHEAST ASIAN SPECIES<sup>1</sup>

1. Metanotal hairs 10-12 single; trumpets shorter and more gradually expanded, 3-6 times as long as greatest width of meatus;<sup>2</sup> base tracheoid for a distance less than apical width ..... Group A, *Mucidus* ..... 2
- Metanotal hairs 10-12 multiple; trumpets long and narrow, index 6-10, with an abruptly expanded apex; base tracheoid for a distance as long or longer than apical width ..... Group B, *Pardomyia* ..... 5
- 2(1). Trumpets moderately long and slender; index 4.0-6.0, average 4.8 ..... 3
- Trumpets shorter and thicker, index 2.8-4.6, average 3.7 ..... 4
- 3(2). Abdominal hair 1-II usually bifid; hair 1-I not dendritic with an average of 6 basal branches ..... *ferinus* (p. 38 )
- This hair usually single; hair 1-I dendritic with 3 or 4 basal branches ..... *laniger* (p. 40 )
- 4(2). Abdominal hair 9-VIII with prominent secondary branching; hair 5-IV-VI single; hair 1-I not dendritic ..... *scatophagoides* (p. 44 )
- Hair 9-VIII with little or no secondary branching; hair 5-IV-VI double; hair 1-I dendritic ... *quasiferinus* (p. 42 )
- 5(1). Paddle with the lateral margin densely and conspicuously spiculate ..... *aurantius aurantius* (p. 47 )
- Paddle with lateral margin vaguely to moderately spiculate ..... *quadripunctis* (p. 50 )

KEY TO THE LARVAE OF SOUTHEAST ASIAN SPECIES<sup>3</sup>

1. Pecten with apical teeth not attaining siphonal tuft; dorsal apical edge of saddle with elongate spines; thorax with hairs 2, 3-P single; abdominal hair 2-VIII single ..... Group A, *Mucidus* ..... 2
- Pecten with the apical 2 teeth somewhat displaced and at least 1 tooth attaining or surpassing the siphonal tuft; dorsal edge of saddle smooth; hairs 2, 3-P multiple; hair 2-VIII double ..... Group B, *Pardomyia* ..... 5

<sup>1</sup>Because of the great variation that occurs within this stage, only typical individuals will key out successfully.

<sup>2</sup>Slide preparations were used to determine these indices. Pupae in spirits may prove to have different averages.

<sup>3</sup>Because of the great variation exhibited in this form, many characteristics could not be used. Distribution is in many cases the only sure means of separation.

- |    |  |                                     |   |
|----|--|-------------------------------------|---|
| 2. | Siphon with siphonal tuft of 8-15 branches;<br>pecten teeth elongate ..... | <i>scatophagoides</i> (p.42 )       | 3 |
|    | Siphonal tuft of 4-7 branches .....  |                                     |   |
| 3. | Pecten teeth moderate in length, 17 or less<br>in number .....             |                                     | 4 |
|    | Pecten teeth elongate; usually more than 17<br>but sometimes less .....    | <i>laniger</i> (p.40 )              |   |
| 4. | Philippines .....  | <i>ferinus</i> (p. 39 )             |   |
|    | Indonesia, Burma, Ceylon.....  | <i>quasiferinus</i> (p.45 )         |   |
| 5. | Indomalayan .....  | <i>aurantius aaurantius</i> (p.47 ) |   |
|    | Philippines .....  | <i>quadripunctis</i> (p.50 )        |   |

## GROUP A MUCIDUS

*Aedes (MUCIDUS) FERINUS* KNIGHT

(Figures 1, 8 A, 10 A, 13 A, 16)

*Aedes (Mucidus) ferinus* Knight 1947, J. Wash. Acad. Sci. 37: 316 ( $\sigma^*$ , L\*);  
Knight & Chamberlain 1948, Proc. helm. Soc. Wash. 15:10 (P\*);  
Knight & Hull 1951, Pacif. Sci. 5:224; Mattingly 1961, Culic. Mosq.  
Indomalayan Area V: 31 ( $\sigma^*$ , ♀, P\*, L\*).

**FEMALE.** (Figure 1) *Head.* Antenna longer than proboscis, light brown with apical segments darker; flagellomere I with a few white scales on mesal margin; torus with a patch of white scales on mesal half; clypeus bare, appearing frosty white in certain lights; palpus yellow brown, approximately 0.8 length of proboscis, basal segment small and slightly inflated with an oblique row of dark bristles, segment II mainly with erect pale scales but the majority with tip dark, segment III with only a few dark tipped scales, the majority white, segment IV all white scaled and the scales mostly decumbent, segments III-IV with many erect bristles on ventral side; proboscis with 4-6 basal bristles, basal half with erect white and dark scales, middle region white and progressing to yellow with a white ring at apex; labellum dark; vertex clothed with narrow erect scales that are forked at apex, medial area from mid vertex to frontal tuft white scaled, sides with mixed white and dark scales; orbital line with narrow decumbent white scales; orbital bristles pale yellow. *Thorax.* Scutum clothed with decumbent, recurved and erect narrow white scales; erect scales forming twisted tufts noticeable in regions of posterior dorsocentral, prescutellar, and supraalar; scutum with some decumbent yellow scales in fossal region; bristles of scutum gold-brown, well developed with acrostichal, anterior promontory, fossal, anterior fossal, and supraalar regions all with many bristles; scutellum with tufts of twisted, erect, white scales on each lobe; scutellar bristles very long and numerous on lateral and medial lobes; pleural integument dark brown with some pleurites with light margins; small erect tufts of white scales in regions of prealar, paratergite, upper sternopleuron, posterior sternopleuron, and anterior mesepimeron; all pleurites with some scales except metapleuron, metameron, and meron; posterior pronotum with approximately 30 bristles, postspiracular with approximately 12, prealar with approximately 27, mesepimeron with approximately 20 upper bristles and 8 anterior and middle bristles combined; anterior pronotum and propleuron with many bristles; postnotum bare. *Legs.* Coxae and trochanters with white scales and several bristles; femora with a basal and apical white band, mid and hind femora with white band at basal third and apical third, dark scales decumbent, white scales erect or decumbent; tibiae

with many erect scales, basal, medial and apical white bands present, apical white band of fore tibia less than 0.25 total length of tibia; fore and mid tarsi unicolorous yellow, tarsomere I with a small basal white band, hind tarsomeres with white bands, tarsomere I with some white scales scattered along its length and 0.8 the combined length of the following tarsomeres, tarsomere II similar to first, tarsomeres III-V white with yellow apices; tarsal claws with one lateral tooth. *Wing*. Squama with fringe of yellow hairs; alula with fringe of narrow scales with dark apices; membranous areas clouded in the regions of the cross veins; veins covered with white, yellow, and dark scales; costa white at base, medial region with yellow and dark scales and the apex usually darker; fringe of wing variably light and dark marked. *Halter*. Stem pale with knob darker and covered with pale scales. *Abdomen*. Terga with lateral, basal tufts of erect white scales and apical fringe of bristles; basal terga darker with white restricted to basal and medial regions; apical segments lighter, segment VII all white; apical segments VIII, IX retracted into segment VII. *Terminalia*. (Figure 8 A) Postgenital plate with apex rounded or slightly truncate; spermathecae 3, 1 larger than the others.

**MALE**. Similar to female in general habitus, but paler. *Head*. Antenna shorter than proboscis, flagellomeres I-XI shortened, densely hairy; torus and flagellomere I with white scales mesially; palpus longer than proboscis, white scaled at base, segments II, III with brown and yellow scales, segment IV with dark, yellow and white scales intermixed, segment V with a basal white band, segments IV, V with ventral tufts of golden hairs. *Legs*. Fore and mid tarsal claws enlarged, unequal, major claw with 2 lateral teeth and twice the length of the minor claw, which has 1 lateral tooth; hind tarsal claws equal in size to those of female, symmetrical, each with 1 lateral tooth. *Wing*. As in female but much paler and with a reduction in the number of scales. *Abdomen*. Scaling of terga primarily white and yellow with few or no dark scales. *Terminalia*. (Figure 10 A) Basimere moderately broad, basal lobe with 2 strong setae on inner face; filament of claspette narrow; aedeagus simple, not toothed; setose lobes of ninth tergite with 3-5 setae on either side.

**PUPA**. (Figure 13 A) Entire surface moderately infuscated, generally dark; trumpets moderate in length with pinna not greatly expanded; index 4-4.5. *Cephalothorax*. Hairs 1-12-C single or terminally forked. *Abdomen*. Hair 1-I somewhat stellate, not dendritic, with several basal branches; hairs 1-3-I single, 4-I forked near apex, 5, 6-I single, 7-I terminally forked, 8-11-I single; hair 1-II usually bifid at middle; hair 1-VII terminally forked, 2-4-VII single, 5, 6-VII double, 7-VII single, 8-VII trifid at half, 9-VII 3-4 branched, 10-VII terminally forked, 11-VII single; hair 9-VIII with 15-18 branches. *Paddle*. Paddles spiculate and with infuscated areas; hair 1-P with 2-4 branches.

**LARVA**. (Figure 16) *Head*. Antenna vaguely spiculate, antennal tuft of 2 hairs at apical fourth; hairs 1, 3-8-C single, 9-C single or double, 10-C double, 11-C single, 12, 13-C double or triple. *Thorax*. Hairs O-P 5-6 branched, 1-3-P single, 4-P 5 branched, 5-7-P single; hair 1-M double, 2, 3-M single, 4-M double, 5-M single; hair 1-T single, 2-T double, 3-T 6 branched, 4-6-T single. *Abdomen*. Hair 2, 4-VIII single; comb patch of over 50 scales, each scale fringed apically and variable in shape; siphon with well developed acus; siphonal tuft at middle, 5-7 branched, branches not plumose; pecten of 12-16 teeth, each tooth usually with 1 lateral tooth, apex moderate in length; saddle incomplete, dorsal apical region with many small spines, longest at apical margin; ventral brush of 30-32 tufts, each tuft of 5-10 branches; anal papillae nearly equal in length, short.

**TYPE DATA**. Holotype  $\sigma$ , with associated skins, San Ramon Penal Farm, Zamboanga, *Mindanao*, PHILIPPINES, 2-X-1945, J. L. Laffoon and K. L. Knight; paratypes, 1 $\sigma$ , with associated skins, same data as type; 15 $\sigma\sigma$ , 3 $\text{♀♀}$ , Zamboanga, *Mindanao*, 12-IX-1945, J. L. Laffoon, D. R. Johnson and K. L. Knight; 1 $\sigma$ , 1 $\text{♀}$ , with associated skins, Olongapo, (Subic Bay), Zambales,

*Luzon*, 21-VII-1945, L. E. Rozeboom and E. S. Zolik; 2♀♀, Dulag, *Leyte*, 25-XI-1945, H. R. Roberts. All in the U.S. National Museum.

DISTRIBUTION. This species is restricted to the PHILIPPINES.

Specimens examined: 29♂♂, 11♀♀, 1 larva, 6 larval skins, and 3 pupal skins as follows: Paratypes, 16♂♂, 4♀♀, with 3 pairs of associated skins, as listed above: *Luzon*, Calaccad (?), 13♂♂, 5♀♀, and 2 unassociated larval skins, 1-III-1963; Labo, Bagacay, 1♀, -X-1968, human biting collection; *Leyte*, Dulag, 1 larval skin, 25-XI-1944, H. R. Roberts; *Mindanao*, San Ramon, 1 larva, 2-X-1945, Knight, Rozeboom and Laffoon; Torrey Barracks, 1♀, Ludlow. Knight & Hull (1951: 225) also record *Luzon*, Tarlac, San Miquel.

TAXONOMIC DISCUSSION. The adult habitus is similar to all members of the Group A *Mucidus*, but small characteristics enumerated in the Key to Species will separate them. The adults of *quasiferinus* and this species are very similar and are most difficult to separate. The female terminalia and the distribution offer the best means for separating the two. The larvae are also similar to *quasiferinus*, but the pupae separate easily on the size and shape of the trumpets. The preceding descriptions were based solely on paratypic material.

BIOLOGY. The type series was collected from light traps and reared from larvae collected in grassy flood pools and marshy pools (Knight 1947: 319).

#### *Aedes (MUCIDUS) LANIGER* (WIEDEMANN)

(Figures 2, 8 C, 10 B, 14 A, 17)

*Culex laniger* Wiedemann 1820, Dipt. exot., Sect. I: 9.

*Mucidus laniger* Wiedemann, Theobald 1901, Mon. Cul. I: 279.

*Mucidus mucidus*, Banks 1906 (*nec* Karsch) Philipp. J. Sci. I: 983.

*Mucidus mucidus*, Leicester 1908 (*nec* Karsch) Stud. Inst. med. Res. F. M. S. 3(3): 69.

*Mucidus mucidus*, Brunetti 1912 (*nec* Karsch) Rec. Indian Mus. 4(10): 440.

*Mucidus laniger* (Wiedemann), Edwards 1913, Bull. ent. Res. IV: 224;

Barraud 1929, Indian J. med. Res. 16: 1053.

*Mucidus laniger* Wiedemann, Brug & Edwards 1931, Tijdschr. Ent. 74: 257.

*Aedes (Mucidus) laniger* (Wiedemann), Barraud 1934, Faun. Brit. Ind. Dipt.

V: 147 (*in part*); Bohart 1945, U.S. Navmed, 580: 51 (*in part* ?);

Knight 1947, J. Wash. Acad. Sci. 37: 320 (♂, ♀)(*in part*); Knight &

Hull 1951, Pacif. Sci. 5: 225; Bonne-Wepster 1954, Roy. trop. Inst.

Amst. Spec. Pub. 106: 59; Mattingly 1961, Culic. Mosq. Indoma-

layan Area V: 31 (♂\*, ♀\*).

FEMALE. (Figure 2) *Head*. Antenna light brown, darker apically, flagellomere I with a few white scales mesally; torus with scattered white scales on mesal half; clypeus bare; palpus light brown, clothed with erect and semi-erect scales, scales of segment II primarily dark tipped with a few white scales randomly placed, segment III similar to II, segment IV mostly white, 0.5 length of II, mainly white scaled but with several dark scales intermixed; proboscis light brown with 4-6 basal bristles, scales of basal half erect and decumbent, dark yellow or brown tipped, apical half with decumbent dark yellow scales with a white ring before labellum; labellum dark; vertex clothed with narrow erect scales which are vaguely forked at apex, a few decumbent hair-like scales beneath, medial area white as in *ferinus*, sides with decumbent white scales; orbital line with moderate decumbent white scales; orbital bristles very pale. *Thorax*. Scales and bristles of scutum, scutellum and pleura similar to *ferinus*. *Legs*. Coxae and trochanters with white scales and rows of bristles; femora with basal and apical white bands, mid and hind femora with white bands at basal third (vague) and apical third, scales both

erect and decumbent, fore femur with a broad but interrupted medial pale band; apical band of fore tibia about 0.33 the length of the tibia, scales of tibia mainly erect; tarsi mainly yellow, fore and mid tarsi unicolorous except for a small basal white band on tarsomere I, and some dark scales on mid tarsomere I, tarsomere I of hind tarsus with a small basal white band and with many erect, dark scales, tarsomere II all yellow brown or infrequently with a narrow (.08 length of tarsomere) basal white band, tarsomeres III-V white with apices yellow and scales decumbent; each tarsal claw with 1 lateral tooth. *Wing*. Squama with fringe of yellow hairs; alula with fringe of long scales with dark tips; vein scales generally darker than *ferinus*, *quasiferinus*, and *scatophagoides*, similar to *nigerrimus*, costa with yellow and dark scales on basal 0.66 and subapical area yellow scaled, apex usually with a dark scale patch; fringe with pale and dark scales. *Halter*. As in *ferinus*. *Abdomen*. Terga mainly dark scaled, terga II-IV with many more dark scales than light, white scales confined to a basal, lateral patch and a medial patch, terga V-VII with more white scales, dark laterally. *Terminalia*. (Figure 8 C) Postgenital plate with apex slightly to moderately emarginate; spermathecae as in *ferinus*.

**MALE.** Similar to female in general habitus but much paler. *Head*. Antenna shorter than proboscis, flagellomeres I-XI shortened with large dorso-ventral projecting tufts of hairs, flagellomeres XII, XIII elongate, without large tufts; torus and basal flagellomere with mesal patches of white scales; palpus longer than proboscis, basal segments with dark and light scales, segments II, III yellow with scattered dark scales and a few white scales present, segments IV, V and apical third of III with ventral tufts of pale hairs, IV, V with basal white bands, scales of segments mainly decumbent except segment V where they are erect. *Legs*. Fore and mid tarsal claws unequal, hind claws equal, as described for *ferinus*. *Wing*. Very pale, white scales few, most scales small and pale; fringe hairs mainly pale; scales of alula small, short and pale. *Abdomen*. Scaling of targa mainly white with darker scales laterally, terminal segments all white. *Terminalia*. (Figure 10 B) As described for *ferinus* and typical for the Group A Mucidus.

**PUPA.** (Figure 14 A) Entire surface infuscated, trumpets slightly elongate, index over 4 but variable, paddles infuscated and showing areas which are clear, or sometimes entirely clear or intergrading between the two. *Cephalothorax*. Hair 1, 2-C single, 3-C 1-3 branched or forked at apical third, 4, 5-C forked or single, 6-C forked, 7-12-C single. *Abdomen*. Hair 1-I multibranched, dendritic with 2-4 basal branches, hair 2, 3-I single, 4-I variable, single, double or forked, 5, 6-I single or forked, 7-I single or bifid, 9-11-I single; hair 1-II single; hairs 1-4-VII single, 5-6-VII double or triple, 7-VII single, 8-VII bifid or trifid, 9-VII 3 or 4 branched, 10, 11-VII single; hair 4-VIII single, 9-VIII with 14-17 branches with little or no secondary branching. *Paddle*. Surface spiculate; hair 1-P double or triple.

**LARVA.** (Figure 17) *Head*. Antenna with acute spicules irregularly placed over entire surface, antennal tuft of 2 hairs at apical 0.25; hairs 1, 3-8-C single, 9, 10-C single or double, 11-C single, 12, 13-C double; mandibles trifid, basal tooth with 4 secondary teeth, apical tooth entire, acute. *Thorax*. Hair 0-P with 3-5 branches, 1-3-P single, 4-P with 4 branches, 5-9-P single, 14-P double or triple; hair 1-3-M single, 4-M double, 5-7-M single, 14-M 5-7 branched; hair 1-T single, 2-T double, 3-T 3 or 4 branched, 6-T single. *Abdomen*. Hair 1, 2-I single, 3-I double, 4-I with 6 branches, 5, 9-I single, 10-I double, 11-I single, 12-I double, 13-I single; hairs 2, 4-VIII single, comb scales in patch of over 60, sometimes over 80; siphon with a well developed acus; siphonal tuft just before middle and of 4-5 non-plumose branches; pecten of 20-22 teeth, apical tooth not attaining siphonal tuft, each tooth usually with only 1 basal, lateral tooth; hair 2, 6, 7-S single, 8-S double, 9-S single; saddle incomplete, apical edge with numerous spines, surface with minute scallopings; ventral tufts of anal segment 30-36, each with 8-12 branches; anal papillae short, ventral pair slightly longer than dorsal pair.

TYPE DATA. Holotype ♀ Batavia, *Java*, INDONESIA, -1815 Westermann, (Universitetets Zoologiske Museum, Copenhagen).

DISTRIBUTION. Specimens examined, 9♂♂, 16♀♀, 12 larvae, 17 larval skins, and 17 pupal skins as follows: THAILAND, *Songkhla*, Hoodyai, 2 km. south Ton Nga Falls, 3♂♂, 3♀♀ with associated skins, 12 larvae, 26-III-1965. PHILIPPINES, *Palawan*, Panakan, 3♂♂, 6♀♀, with associated skins, 4 unassociated skins, 29-XI-1967; *Luzon*, Dagupan, 1♀, -II-1945. WEST MALAYSIA, Kuala Lumpur, 1♂, 1♀, 1912, G. F. Leicester; Segambut, 1♀, 12-III-1955; *Selangor*, 1♀, 4-II-1948. SINGAPORE, Coronation Road, 1♀, 5-V-1921. INDONESIA, *Sumatra*, Djambi, 1♂, 1♀, -II-1923, DeRook; Deli, 1♀, -1914, A. J. Stanton; Poelau Radjo, 1♂, -I-1932. Parrish (1968: 4) records *laniger* at light, SOUTH VIETNAM, Pleiku.

TAXONOMIC DISCUSSION. In the past there was some doubt as to the exact determination of *laniger* (Knight 1947: 320, Knight & Hull 1951: 225). Mattingly (1961: 26) has examined Wiedemann's type and found the material originally assigned to this species by Knight as being correct.

This form is related to the Ethiopian forms in the presence of a large, apical pale band on the fore tibia. It differs from others in Group A *Mucidus* in the usually all brown second hind tarsomere. However, several specimens from the Philippines have a basal white band of one scale in thickness - approximately 0.08 the length of the tarsomere - on this segment. The previously unknown immatures are extremely variable. The larvae normally have more than 17 pecten teeth but a few individuals have less. The pecten teeth are unique in having that portion apical of the lateral tooth elongate, a character *laniger* shares with *scatophagoides*. The larvae differ from *scatophagoides* in the fewer branches of the siphonal tuft, and from *ferinus* and *quasiferinus* by the elongate apex of the pecten teeth. The pupae differ from *ferinus* in having hair 1-I dendritic whereas in *ferinus* it is stellate, and from *scatophagoides* in the lack of noticeable secondary branching in hair 9-VIII.

BIOLOGY. Material from the Philippines was collected in a stagnant ditch with some emergent vegetation. The material from Thailand was collected in a turbid flood pool that was lightly shaded and with marginal grass and rotten leaves. From this same pool were collected *Anopheles balabacensis*, *pollicaris*, *Aedes imprimens*, and *alboscuteclatus*.

### *Aedes (MUCIDUS) QUASIFERINUS* MATTINGLY

(Figures 6, 7, 8 B, 11 A, 13 B, 18)

?*Culex laniger* Thwaites 1859, in Tennent's Ceylon, I: 268.

*Mucidus laniger* Wiedemann, Edwards 1922, Indian J. med. Res. 10:462 (*in part*); Brug & Edwards 1931, Tijdschr. Ent. 74: 257 (*in part?*).

*Aedes (Mucidus) laniger* (Wiedemann), Barraud 1934, Faun. Brit. Ind. Dipt. 5: 147 (♂\*, ♀\*); Carter 1950, Ceylon J. Sci., B 24:101.

*Aedes (Mucidus) quasiferinus* Mattingly 1961, Culic. Mosq. Indomalayan Area V: 32 (♂\*, ♀\*, P\*, L\*).

*Aedes (Mucidus) ferinus*, Thurman 1963 (*nec* Knight) 9th Pacif. Sci. Congr. Proc. 9: 55.

FEMALE. (Figure 6) *Head*. Antenna dark brown, flagellomere I with a narrow row of white scales on mesal margin; torus with an apical patch of white scales on mesal half; clypeus as in *ferinus*; palpus brown, clothed with erect and semi-erect scales, basal segments dark scaled with some white scales intermixed, apical segments lighter with the distal segment all white; proboscis with 6 basal bristles, scales erect and semi-erect on basal half, decumbent on apical half, base dark scaled blending to white at middle and then to yellow on the apical sixth, apex with a narrow white ring before labellum; labellum moderately dark; vertex clothed with narrow erect scales which are

vaguely forked at apex and a few narrow decumbent white scales beneath these, medial area white but sides also pale, erect scales white or yellow brown; sides with decumbent white scales; orbital bristles pale. *Thorax*. Erect scales of upper sternopleuron and anterior mesepimeron very narrow and long, nearly as long as the tufts on scutum; other scales and bristles of scutum, scutellum and pleura similar to *ferinus*. *Legs*. Coxae and trochanters with white patches and rows of bristles; scales both erect and decumbent; femora with basal and apical white bands and small white bands at basal and apical third, those of fore femur somewhat blended by white scales in between; tibia with basal and apical white bands, hind tibia with a median white band, mid tibia with a vague median band or reduced to a few white scales, fore tibia with median white band either present and large, reduced to a few white scales, or infrequently absent, usually with an interrupted band; tarsi yellowish, fore and mid tarsi with a basal white band on tarsomere I, hind tarsomeres yellow brown with white bands, hind tarsomere I equal to or slightly shorter than following tarsomeres combined, with a short basal white band, hind tarsomere II similar to first but less than half its length, hind tarsomeres III-V white with some yellow at apices and all scales decumbent; tarsal claws equal with one tooth. *Wing*. Squama with fringe of yellow hairs; alula with long, thin scales along margin, mainly pale, not dark tipped; vein scales white, yellow, and brown; costa yellowish, especially near apex, apex without a very dark spot at tip but with a moderate to pale brown spot; fringe variable, marked with pale and dark. *Halter*. Halter with pale scales over entire surface. *Abdomen*. Terga II and III yellow scaled with patches of white along basal margin, apical terga more white, yellow confined to lateral, apical margin, segment VII all white. *Terminalia*. (Figure 8 B) Postgenital plate slightly to moderately emarginate at tip; spermathecae similar to others in Group A Mucidus, but of 3 distinct sizes.

**MALE.** (Figure 7) Similar to general habitus of female but paler. *Head*. Antenna shorter than proboscis, basal 11 joints shortened with dense tufts of hair projecting dorso-ventrally, flagellomeres XII, XIII elongate without tufts; torus and basal flagellomere with white scales on mesal side; palpus longer than proboscis, basal segments light, segment I and base of segment II mostly white, remainder of segment II yellow with some scales dark tipped, segment III with a basal and apical white band, segment IV white, V white at base and apex with some dark scales in between; proboscis dark at base with or without a median white band, yellowish overall with a white ring at apex. *Legs*. Fore and mid tarsal claws unequal, hind claws as in female, typical of group. *Wing*. Wing pale but darker than male *laniger*; fringe hairs with some dark markings; scales of alula very small and all pale. *Abdomen*. Scaling of terga white and yellow, all terga with some yellow scales laterally except terminal segment which is all white. *Terminalia*. (Figure 11 A) Similar to *ferinus* and *laniger* but averaging a larger number of setae on the apex of the ninth tergite.

**PUPA.** (Figure 13 B) Entire surface deeply infuscated; trumpets moderate to very broad with index 3-3.75. *Cephalothorax*. Hairs 1-4-C single, 5-C bifid, 6-12-C single. *Abdomen*. Hair 1-I multibranched, dendritic, 2,3-I single, 4-I trifid, 5,6-I single, 7-I trifid, 9-I single; hair 1-II single or bifid at middle; hairs 1-4-VII single, 5-VII double, 6-VII small, bifid or trifid, 7,8-VII single, 9-VII 3-5 branched, 10,11-VII single; hair 4-VIII single, 9-VIII with 13-16 branches and some secondary branching. *Paddle*. 1-P bifid; entire surface spiculate, infuscation absent in some areas producing a bicolored appearance.

**LARVA.** (Figure 18) Specimens examined had the thorax and parts of the abdomen partially destroyed but have been reconstructed in the illustration. *Head*. Antenna sparsely spiculate, antennal tuft of 2 hairs at apical 0.25; hairs 1,3-8-C single, 9-C single, 10-C bifid, 11-C single, 12,13-C bifid; mentum with 6-7 lateral teeth. *Abdomen*. Hairs 2,4-VIII single; comb

patch of over 50 scales, each scale narrow and fringed; siphon with acus well developed; siphonal tuft just before middle, of 4-6 hairs; pecten not reaching tuft, of 9-15 teeth each moderate in length with 1 basal, lateral tooth, distal tooth usually entire; saddle incomplete, apical edge similar to *ferinus* and *laniger*; ventral brush of 27-30 hair tufts, each with 6-9 branches; anal papillae short, ventral pair slightly longer than the dorsal pair.

TYPE DATA. Holotype ♀ with associated skins, Sungei Besi, Kuala Lumpur Area, *Selangor*, WEST MALAYSIA, -II-1955, W. W. Macdonald; paratypes, 1♀, Airport, Kuala Lumpur, *Selangor*, 3-II-1955, W. W. Macdonald; 1♂, Kampong Sireh, *Selangor*, 7-IV-1953; 1♀, SINGAPORE; 1♀, Dermajoe, Benkoelen, *Sumatra*, INDONESIA, 9-XII-1929, Brug and DeRook; 2♀♀, Karta Agoeng, *Sumatra*, -1925, Rodenwaldt; 1♂, ASSAM, Christophers; 1♂, Frae, THAILAND, 5-II-1928, A. Mackie; 1♀, Trincomalee, CEYLON, -1915, C. F. S. Baker. All in the British Museum.

DISTRIBUTION. Specimens examined: I have examined all but one of the paratypes plus 9♂♂, 12♀♀, 1 larval skin, and 15 pupal skins as follows: THAILAND, *Lampoon*, Lampoon, 1♀, -1952; *Chiang Mai*, Muang, 1♂, -1964; *Chiang Mai*, Heuy Chang Kien, 1♀, -1962; Ban Muang Kao, 7♂♂, 9♀♀, with 2 associated larval skins and 15 associated pupal skins; 14-VII-1966; Banshiyok, 1♂, -1965. WEST MALAYSIA, *Selangor*, Jinjang, 1♂, 12-VIII-1956, H. C. Barnett.

TAXONOMIC DISCUSSION. The adults of this species and *ferinus* are very similar. The geographic distribution and the shape of the postgenital plate of the females are the best methods for separation. The pupae are similar to *alternans* and *ferinus* but differ as follows: from *ferinus* by the much stouter and shorter trumpets, and from *alternans* in having more branches, 12-15 in hair 9-VIII (6-9 in *alternans*) and in hair 1-IV-VI (double in *alternans*, single in *quasiferinus*). Because of the variation found in the characters that have been employed in the past to separate *ferinus* and *quasiferinus* larvae, I suggest the use of distribution. I have examined the skins of 3 paratypes of *ferinus* and the stem of the hair tufts of the ventral brush and the comb scales do not show distinct differences (Mattingly 1961: 25).

BIOLOGY. The holotype was reared from larvae collected from a stagnant earth drain. Material from Thailand was collected from a partially shaded flood pool which was stagnant and contained floating dead leaves. In the same pool were collected the larvae of *Anopheles maculatus*, *Aedes albo-scutellatus*, *mediolineatus*, *caecus*, *culicinus*, and *Culex annulus*.

#### *Aedes (MUCIDUS) SCATOPHAGOIDES* (THEOBALD)

(Figures 3, 9 C, 11 B, 14 B, 19)

*Culex laniger*, Macquart 1839 (*nec* Wiedemann), Mem. Soc. Sci. Lille 1(2): 292.

*Mucidus scatophagoides* Theobald 1901b, Mon. Cul. I: 277 (♀\*); Giles 1902, Handbook 2nd. ed., p. 348 (♀); Christophers 1906, Sci. Mem. Med. San. Depts. India 25 (n. s.): 13; Barraud 1929, Indian J. med. Res. 16: 1053.

*Mucidus scatophagoides* Theobald, Edwards 1911, Bull. ent. Res. 2: 246 (emend.); Brunetti 1912, Rec. Indian Mus. 4(10): 440; Edwards 1922, Indian J. med. Res. 10: 450.

*Aedes (Mucidus) scatophagoides* (Theobald), Edwards 1932, Gen. Insect., Fas. 194: 133; Barraud 1934, Faun. Brit. Ind. Dipt. 5: 138 (♂\*, ♀, L\*); Knight 1947 (*in part*), J. Wash. Acad. Sci. 37: 319 (♂\*, ♀); Mattingly 1961 (*in part*), Culic. Mosq. Indomalayan Area, V: 18.



**FEMALE.** (Figure 3) *Head.* Antenna light to dark brown, flagellomere I with a moderate patch of white scales on mesal margin; torus with white scales on mesal half; clypeus bare, typical for the group; palpus brown 0.66 length of proboscis, segment I small and dark, segment II with erect white and yellow scales, the yellow scales with dark tips, segment III mostly white scaled with scales at base decumbent, segment IV all white scaled; proboscis with 6 basal bristles, scales mainly decumbent but with some erect and semi-erect scales on basal half, scales dark and white at base, white at middle, and yellow with some dark tipped scales at apex, no white ring at apex; labellum light to dark brown; vertex clothed with erect and decumbent scales, erect scales white and dark, narrow, few forked, with some narrow decumbent white scales beneath; orbital bristles pale; orbital line with decumbent white scales. *Thorax.* Scales and bristles of scutum, scutellum and pleura typical for Group A Mucidus. *Legs.* Coxae and trochanters with white scale patches and rows of bristles; femora with basal and apical white bands, mid and hind femora with white bands at basal and apical third, band at basal third sometimes absent, fore femur with many white scales, basal white band sometimes enlarged covering 0.33 of femur, scales of femur small and decumbent on basal 0.5, larger and with some erect scales near apex; tibia with basal, medial, and apical white bands, scales erect, semi-erect and decumbent, darker scales very dark brown; tarsi with most segments with white bands, hind tarsomere I variable, as long as, or slightly shorter, than following segments combined, with basal and medial white bands, tarsomeres II, III with basal white bands, all scales decumbent with some semi-erect dark tipped scales on hind tarsomere I; fourth and fifth tarsomeres of fore and mid tarsi with or without white bands; tarsal claws equal with 1 tooth. *Wing.* Squama with fringe hairs pale; alula with fringe of long, thin, pale scales, not dark tipped; vein scales yellow, white and brown; costa and R<sub>1</sub> usually entirely yellow on apical third; fringe with distinct dark and white bands of variable size. *Halter.* Halter pale with light scales noticeable at apex. *Abdomen.* Basal terga with yellow and dark tipped yellow scales in predominance, white scales confined to lateral tufts and a median patch or stripe, segments VI and VII mostly all white with some lateral yellow scales. *Terminalia.* (Figure 9 C) Postgenital plate slightly emarginate at middle of apex; cerci with thin setae over entire surface.

**MALE.** Similar to female in general habitus but slightly paler. *Head.* Antenna shorter than the proboscis with basal 11 flagellomeres shortened and clothed with tufts of long, dorso-ventrally projecting hairs, hairs near base 0.5 as long as the antenna, flagellomeres XII and XIII elongate without tufts, basal flagellomere with white scales mesally; torus bare; palpi longer than proboscis by 0.2, segment I and 0.5 of segment II predominantly white scaled, apical region of segment II with yellow and dark tipped yellow scales, segment III 0.5 white, dark portion with many long, ventrally projecting hairs, segment IV white at base and apex with numerous long hairs, segment V with yellow and white scales and shorter hairs beneath; proboscis mainly yellow scaled with a few white scales on basal half and a median narrow white band. *Legs.* Fore and mid tarsal claws unequal, major claw 0.66 length of fifth tarsomere with 2 blunt teeth, minor claw 0.5 length of major claw and with 1 tooth, hind claws as in female. *Wing.* Costa and R<sub>1</sub> mostly yellow scaled, scales much smaller and fewer than in female. *Abdomen.* Scales reduced in number but pattern similar to female, erect scales expanded at apex and truncate. *Terminalia.* (Figure 11 B) This species is distinct in having a raised carina on the aedeagus that is prolonged apically in the form of a tooth, large setae on basal lobes of basimeres with an odd structure embracing the base of the seta, structure acute on one side, rounded over the rest of the surface, otherwise similar to the typical form.

**PUPA.** (Figure 14 B) Surface only slightly infuscated, trumpets short and stout with an average index of 4. *Cephalothorax.* Hair 1-3-C single,

4-6-C single, bifid or trifid, 7-12-C single. *Abdomen*. Hair 1-I multibranch-  
ed, somewhat stellate, 2, 3-I single, 4-I trifid, 5-I bifid or trifid, 6-I single,  
7-I bifid, 9-I single or forked; hair 1-II short, bifid near base; hair 1-4-VII  
single, 5-VII with 2-5 branches, 6-VII multibranch-  
ed and very small, 7-VII  
single, 8-VII 4-6 branched, 9-VII with 4 branches, branches may show second-  
ary branching, 10, 11-VII single; hair 4-VIII single, 9-VIII with 9-16 branches,  
many with up to 4 secondary filaments. *Paddle*. Surface spiculate, without  
dark infuscated areas; hair 1-P single or double or infrequently with small  
secondary filaments.

LARVA. (Figure 19) *Head*. Antenna spiculate, antennal tuft of 2  
or 3 hairs at distal fourth; hair 1, 3-8-C single, 9-C 2-4 branched, 10-C dou-  
ble, 11-C single, 12, 13-C with 3-4 branches; mentum as in *quasiferinus*.  
*Thorax*. Hair 0-P with 3-4 branches, 1-3-P single, 4-P with 4 branches,  
5-7-P single, 7-P double, 9-P single, 14-P single or double; hair 1-3-M sin-  
gle, 4-M double, 5-7-M single, 14-M with 12-13 branches; hair 1-T single,  
2-T double or triple, 3-T with 4 branches, 5, 6-T single. *Abdomen*. Hair 1-I  
single, 3-I double, 4-I with 5-6 branches, 5-I single, 10-I double, 11-I single,  
12-I double, 13-I single; hair 1-II short, bifid; hair 1-VII bifid, 2, 3-VII sin-  
gle, 4, 5-VII single or bifid, 6-VII with 4 branches, 7-VII single, 8-VII 5  
branched, 9-12-VII single, 13-VII with 5 branches; hairs 2, 4-VIII single;  
comb scales over 50, fringed apically; siphon with a well developed acus, si-  
phonal tuft just before middle with 9-15 branches, pecten of 20-30 teeth, each  
with 1, rarely 2, lateral teeth, distal tooth displaced from pecten but not  
reaching siphonal tuft, hairs of siphon as in *quasiferinus*; ventral brush of 25-  
28 tufts, each with 7-11 branches; anal papillae short, nearly equal in length.

TYPE DATA. Lectotype ♀ (Selected by P. F. Mattingly), Gajraula,  
29 m. w. Moradabad, N. W. Provinces, INDIA, -X-1900, Giles; cotype ♀ (so  
labelled), Myingyan, *Mandalay*, BURMA. Both in the British Museum.

DISTRIBUTION. Specimens examined: 2♂♂, 19♀♀, 2 larvae, 7  
larval skins, and 5 pupal skins as follows: SOUTH VIETNAM\*\*, Dong Ba  
Thin, 1♀ with associated skins, 3-VIII-1966, Frolic; Hoa Da, 1♀ with associ-  
ated skins, 3-VIII-1966, Haws; Nah Trang, 1 larva and 1 larval skin, 9-XI-  
1966, Nourse. INDIA, Delhi, 1♀ with associated skins, 10-X-1927, R. S.  
White; *Punjab*, Karmal, 1 larva, 3 larval skins, and 2 pupal skins, -VII-1930,  
P. J. Barraud; *Punjab*, Pathankote, Railway Car Ridge, 1♀, 6-IX-1906, C.  
Barrows; *N. Canara*, Karwar, 1♂, 3♀♀, H. Cogill; India, 1♀, Christophers;  
n. w. India, 1♀; Amritsar, 1♂, 2♀♀; *Bengal*, Calcutta, 2♀♀, 4-VIII-1944, D. E.  
Hardy. WEST PAKISTAN, *Lahore*, Kahna Kacha, 5♀♀, 24-VIII-1962, D. H.  
Gould; same data, 1♀, 6-IX-1962; same data, 1♀, 14-IX-1962; same data, 1♀,  
4-VIII-1962. Knight (1947: 320) includes CHINA, Hongkong. Mattingly (1961:  
18) includes BURMA and CEYLON.

TAXONOMIC DISCUSSION. The adults of this species resemble in  
general habitus the other members of the *Mucidus* Group. They differ, how-  
ever, in having a medial white band on the first tarsomere. This character  
is shared with *alternans* from the Australasian Region and *sudanensis* from  
Africa, but they can easily be separated. The apical white band of the femora  
is subapical in *alternans* and apical in *scatophagoides* and *sudanensis*. The  
latter can be separated on the presence of white scales on the proboscis  
(*scatophagoides*) or the proboscis entirely yellow scaled (*sudanensis*). The  
males of *scatophagoides* and *sudanensis* apparently differ from all other  
*Mucidus* in having the torus without scales. Both males examined has seg-  
ments IV and V of the palpus contorted and laterally or dorso-ventrally flat-  
tened. I doubt that this is a natural condition and probably resulted from kil-  
ling freshly emerged individuals. Knight (1947: 319) noted a difference between

\*\* New record.

the Oriental and Ethiopian specimens. Examination of additional material by Tyson (1970) has confirmed his opinion that Theobald's *sudanensis*, synonymized by Edwards (1911: 246) is distinct. Macquart mentioned *Culex laniger* Wiedemann in his 1839 work. He stated it was probably different from the true *laniger* and that it had bands on all tarsal segments. Because of the leg banding it is almost certain that he was referring to the then undescribed *scatophagoides*.

The larvae differ from other Oriental *Mucidus* by the elongate apex of the pecten teeth and the number of branches of the siphonal tuft. Hopkins (1951: 121) illustrated a larva which may not have been a fourth instar. It had 21 comb scales and in his description states the norm to be 30-40. I have not seen mature larvae with less than 48 comb scales. The pupae differ in the amount of secondary branching on hair 9-VIII, and with hairs 1,3-III-VI long and single.

**BIOLOGY.** Barraud (1934: 146) lists open natural pools as breeding sites. Material from Vietnam was reared from larvae collected in a ditch, a rice paddy, and a swamp.

#### GROUP B PARDOMYIA

#### *Aedes (Mucidus) aurantius aurantius* (THEOBALD)

(Figures 6, 7, 9 A, 12 A, 15 B, 20)

- Pardomyia aurantia* Theobald 1907, Mon. Cul. 4: 280 (♀); Edwards & Given 1928, Bull. ent. Res. 18: 341 (P\*, L\*).
- Ekrinomyia aureostriata* Leicester 1908, Stud. Inst. med. Res. F.M.S. 3(3): 71 (♂, ♀); Brunetti 1912, Rec. Indian Mus. 4(10): 440.
- Mucidus (Pardomyia) aurantius* (Theobald), Brug & Edwards 1931, Tijdschr. Ent. 74: 257.
- Aedes (Mucidus) aurantius* (Theobald), Lee 1944, Atlas Mosq. Larvae Australasian Region, p. 51 (L\*); Brug & Bonne-Wepster 1947, Chronica Naturae 103: 184; Macdonald 1957, Stud. Inst. med. Res. F.M.S. 28: 17; Mattingly 1961, Culic. Mosq. Indomalayan Area V: 33 (♂\*, ♀\*, P\*, L); Assem & Bonne-Wepster 1964, Zool. Bijdr. 6:78 (♀, L).
- Aedes (Mucidus) aurantius aurantius* (Theobald), Knight, Bohart & Bohart 1944, Natl. Res. Council, Div. med. Sci., p. 33; Knight 1947, J. Wash. Acad. Sci. 37: 323 (♂, ♀, L).

**FEMALE.** (Figure 6) *Head.* Antenna light at base becoming dark brown apically, nearly as long as proboscis; torus with thin setiform gold scales on mesal half; clypeus light brown or yellow, bare; palpus short, approximately 0.25 the length of the proboscis, segment I short, mainly yellow scaled but with a few dark scales randomly placed, segment II with many erect hairs on dorsal surface, yellow scaled or with a few randomly placed dark scales, segment III elongate, longer than preceding segments combined, yellow scaled or yellow with apex black, segment IV short, bulbous, usually dark scaled; proboscis slender, yellow scaled with scales decumbent, semi-decumbent on ventral basal half, dark scales at ventral, lateral base, a ring at apex, and a few sometimes scattered along dorsum; labellum dark; vertex clothed with erect and decumbent scales, erect scales yellow, slightly forked at apex, decumbent scales beneath these, narrow and bright shining yellow; orbital line with bright yellow scales not separated from decumbent scales of vertex; orbital bristles pale. *Thorax.* Integument dark brown; scutum clothed with erect bristles and thin, decumbent scales, anterior region with a transverse band of bright yellow scales which also includes the anterior and posterior pronotum laterally, rest of scutal scales dark coppery brown with a few

scattered yellow scales on basal half (prescutellar, etc.); scutellum yellow scaled; postnotum bare; pleura dark with small patches of decumbent yellow scales, bristles similar to *Mucidus* Group but anterior and medial mesepimerals reduced to 1-5. *Legs.* Coxae and trochanters with rows of bristles and yellow scale patches; femora with basal and apical yellow bands, scales all decumbent, color variable but usually mottled with small yellow and dark bands; tibia with a small basal yellow band and an apical dark band, scales mainly decumbent but hind tibia with some semi-erect dark scales; tarsi variable, fore tarsi mottled, light beneath, darker dorsally, mid tarsi with tarsomere I all yellow or mottled yellow and dark, apical segments of fore and mid tarsi with vague basal yellow bands, hind tarsi dark, segments I-III with basal yellow bands, segment IV with or without a basal yellow-white band, segment V all white; fore and mid tarsal claws equal, each with 1 tooth, hind claws equal, simple. *Wing.* Scaling of wings much reduced as compared to *Mucidus* Group, scales small, yellow and dark, scales of costa and  $R_1$  much larger than scales on other veins; fringe not banded, dark; squama with fringe of dark hairs, alula with thin, dark scales at margin. *Halter.* Halter frosted, whitish at base, dark at apex with thin dark scales. *Abdomen.* Variable; tergum I dark scaled, terga II, III dark scaled with yellow scales at base and 2 yellow spots at middle on each side of the median line, these spots may be joined on tergum III, terga IV-VII yellow scaled with scattered dark scales usually laterally. *Terminalia.* (Figure 9 A) Typical for this group; postgenital plate deeply emarginate; spermathecae 3, 1 larger than the remaining 2.

**MALE.** (Figure 7) Similar to female in general habitus. *Head.* Antenna shorter than proboscis, flagellomeres I-XI shortened with long tufts of hair that project mainly dorsally and ventrally, flagellomeres XII, XIII elongate, over 0.5 the length of preceding ones combined, without large tufts of hairs; palpus slightly longer than proboscis, segment I short, yellow or yellow with apex dark, segment II yellow or yellow with base dark, segment III yellow at middle, segments IV, V yellow at base, apex of segment III, segment IV and base of segment V with ventral tufts of long hairs; proboscis as in female. *Legs.* Tarsal claws of fore and mid tarsi unequal, both major and minor claws with 1 tooth, hind tarsal claws equal, entire. *Wing.* Scale fringe of alula pale, otherwise as in female. *Terminalia.* (Figure 12 A) Typical for the subgenus but with the basistyle more slender (common to *Pardomyia*); accessory lobe of the stem of the claspette small with a stout hair at its apex.

**PUPA.** (Figure 15 B) Trumpets long and narrow, pinna wider, base tracheoid for 0.33 the total length of the trumpet; index 6-10, averaging 8. *Cephalothorax.* Hairs 1-12-C multibranching, variable. *Abdomen.* Hair 1-I with many plumose branches, 2-I single, 3-7-I multibranching, variable; hair 1-II single, long; hairs 1, 2-VII single, 3-VII with 3 branches, 4-VII double, bifid, or trifid, 5-VII with 3-5 branches, 6-VII with 4-5 branches, 7-VII single, 8-VII trifid, 9-VII with 4 branches, 10-VII single or bifid, 11-VII multiple at apex; 4-VIII 1-3 branched, 9-VIII with 8-11 plumose branches. *Paddle.* Margin densely spiculate; 1-P single.

**LARVA.** (Figure 20) *Head.* Antenna sparsely spiculate, antennal tuft at apical fifth of 3-5 hairs; hairs 1, 3-8-C single, 9-C double, 10-C triple, 11-C bifid, 12-C triple, 13-C with 4 branches, 14, 15-C divided. *Thorax.* Hair 0-P multibranching, 1-P single, 2-P double, 3-P with 2-4 branches, 4-P with 2-3 branches, 5-7-P single, 8-P with 9 branches; hair 2-M double, 3-M double, 4-M with 3 branches, 5-7-M single, 8-M multibranching, 4-T small, multibranching, 5-T single, 7-T multibranching, 8-T multiple, 9-T multibranching, 10-12-T single. *Abdomen.* Hair 1, 2-I single, 3-I triple, 4-I multibranching, 5-I small, multibranching, 6-I single, 7-I with 7-8 branches, 9-I bifid, 10-I triple, 11-I small, multibranching, 12-I single; hair 1-VII with 2 branches, 2-VII single, 3-VII double or triple, 4-VII single, 5-VII single, 6-VII multibranching, 7-VII single, 8, 9-VII multiple, 10-VII 3-5 branched, 11-VII single, 12-VII with 2-4 branches, 13-VII with 3-5 branches; hair 2-VIII with 2-3 branches, 4-VIII single; comb teeth small, fringed, 60-82 in number;

siphon with acus well developed, siphonal tuft beyond middle, of 9-11 plumose branches, pecten of 20 or more teeth, each with 1 or 2 lateral teeth, apical tooth usually entire and displaced from the pecten, surpassing the siphonal tuft; saddle incomplete, hair 1-X at middle near apex of segment, ventral brush of 22-25 tufts, each of 6-11 branches; anal papillae short, ventral pair slightly longer than dorsal pair.

TYPE DATA. Holotype ♀, Kuching, *Sarawak*, EAST MALAYSIA, -XI-190-, Barker. Types of *aureostriata* as follows: lectotype ♀ and allotype ♂, Fort Road, Klang, WEST MALAYSIA, 7-I-1904, Leicester, from pupae in a mud hole. All in the British Museum.

DISTRIBUTION. Specimens examined: 10♂♂, 17♀♀, 9 larval skins, and 9 pupal skins as follows, types, 2♂♂, 1♀ paratypes, 1♀ cotype (*aureostriata*), and 8 unassociated larval and pupal skins, WEST MALAYSIA, *Selangor*, Kuala Lumpur, -1912, Leicester; *Selangor*, Rantau Panjang, 1♂, 1♀, 19-II-1954, W.W. Macdonald; same data, 2♂♂, 3-VII-1952; same data, 2♂♂, 13-II-1957; same data, 1♀, 25-II-1952; same data, 1♂, -VII-1956; same data, 2♀♀, 9-IV-1952; same data, 1♀, 4-III-1953. SINGAPORE, 1 larval skin, 1 pupal skin, D. Given. EAST MALAYSIA, *Sabah*, Darat, Berbulah, 1♀, 14-VII-1965; *Sabah*, Membakut, 1♀, -1913, Roper; *Sabah*, Kuala Abai, 2♀♀, 7-IX-1965; *Sarawak*, Kuching, 1♀, Moulton. INDONESIA, *Celebes*, Polewali, 1♀, 1-III-1926, Kaiser; *Celebes*, Kalawara, 1♀, 8-II-1937, J. Brug; *West Irian*, Hollandia, 2♂♂, 2♀♀, 12-VII-1944, E.S. Ross. KIRIWINA ISLAND, 1♀. Brug & Edwards (1931: 257) includes INDONESIA, *Doerian*. Mattingly (1961: 36) includes INDONESIA, *Sumatra*.

TAXONOMIC DISCUSSION. The adult habitus is similar to that of *painei* (Figure 7) from the Solomon Islands. The males are nearly inseparable but the females differ in the scale pattern on the terga of the abdomen. Also similar is *quadripunctis* but differs in the coloration of the integument and the scales of the scutum and abdomen. The intraspecific variation exhibited in the subgenus is somewhat less in Group B *Pardomyia*, but it does occur in the immature forms. Mattingly (1961: 34) noted variations in the color of mid tarsomere I in specimens from Sumatra and Borneo. I have seen additional material which shows this character to occur randomly throughout the range of this species. One specimen from the Celebes shows similarities to *quadripunctis*. The palpi and proboscis are entirely yellow and the legs are mostly yellow. Also, the integument is somewhat lighter than the typical *aurantius*.

Presently I am unable to separate the larvae of this species and *quadripunctis*. Knight (1947: 324) suggested that there might be a difference in the number of branches in the siphonal tuft. In all the material examined (*aurantius*, *painei*, and *quadripunctis*) the same variation in the number of branches was seen. Edwards & Given (1928: 341) showed the comb scales as being 20-26 (as cited by Knight). Mattingly states "about 50" being the average in specimens he examined. My observations show the comb scales to vary between 50 and 82 per patch, and may even go higher. Edwards & Given were probably examining a third instar larva which may account for the lower number of scales.

The pupae show close similarities in chaetotaxy to *painei* and *quadripunctis*. They differ from *painei* in the shape of the trumpets, which are gradually expanded to the pinna in *painei*, and from *quadripunctis* by the more densely spiculate paddles. Penn (1949: 41) described and figured the pupae of *aurantius chrysogaster* as differing in abdominal hair 1-I having 3-4 secondary branches. I have examined 5 slides of this subspecies from Australia and 4 of the 5 had hair 1-I single, without secondary branches, the fifth was as Penn described.

The relationship between the species in this group is interesting. It is certain that they arose from a common ancestry and have or are now reaching a point of speciation. I feel the 3 forms deserve separation until biologic or cytotaxonomic studies prove otherwise.

**BIOLOGY.** Like other members of the subgenus, *aurantius* immatures are found in temporary pools of various types. Those listed in the literature include pig wallows, small holes in marshy ground, grass-grown pools, pot-holes in mangrove swamps, ground pools among nipa palms, and clear marshy pools. Adults have been collected while feeding on man and domestic animals.

*Aedes (MUCIDUS) QUADRIPUNCTIS* (LUDLOW)

(Figures 4, 9 B, 12 B, 15 A, 21)

- Pardomyia quadripunctis* Ludlow 1910, in Theobald, Mon. Cul. 5: 608 (♀); Brunetti 1912, Rec. Indian Mus. 4(10): 460; Dyar & Shannon 1925, Insec. Inscit. Menst. 13: 73.
- Aedes (Mucidus) aurentius* var. *quadripunctis* Ludlow, Edwards 1932, Gen. Insect., Fasc. 194: 135.
- Aedes (Mucidus) aurentius quadripunctis* (Ludlow), Knight & Hull 1951, Pacif. Sci. 5: 224.
- Aedes (Mucidus) quadripunctis* (Ludlow), Bohart 1945, U.S. Navmed 580: 55; Knight 1947, J. Wash. Acad. Sci. 37: 322 (♂, ♀, L\*); Mattingly 1961, Culic. Mosq. Indomalayan Area V: 26 (♂\*, ♀, P\*).

**FEMALE.** (Figure 4) *Head.* Antenna brown, nearly as long as the proboscis; torus yellow-gold with yellow scales on mesal half; clypeus light brown, bare; palpus short, approximately 0.25 the length of the proboscis, segments I and II short, yellow-gold scaled with erect hairs on segment II, segment III yellow-gold, elongate, longer than preceding segments combined, segment IV short, bulbous, apex of segment III and segment IV dark scaled; proboscis slender, yellow-gold scaled, scales mostly decumbent, semi-decumbent on ventral, basal half, base with several dark brown scales on ventral and lateral margins, apical half with scattered dark scales on dorsal surface; labellum dark; vertex clothed with narrow, decumbent, light yellow scales, above these are erect, forked at apex, and slightly darker scales; orbital bristles pale. *Thorax.* Scutum clothed with erect bristles and narrow, decumbent scales, scales yellow-copper, bristles darker yellow; integument light reddish-brown; generally similar to *aurantius*; medial and anterior mesepimeral bristles usually absent. *Legs.* Femora and tibiae as in *aurantius* but lighter due to the lighter integument; tarsi also lighter, hind tarsomeres usually with pale basal bands on I, II, sometimes on I-III, or all dark; tarsal claws as in *aurantius*. *Wing.* Scales of alula setaform, narrower than in *aurantius*. dark; squama with fringe dark; scales of wing much reduced, most noticeable on costa and R<sub>1</sub>; clouded regions of cross veins easily seen; fringe hairs of wing longer at base than apical 0.3. *Halter.* Halter light brown with some scales on expanded apex. *Abdomen.* Variable, generally entirely yellow-gold scaled dorsally, segment VII with lateral margins dark scaled; ventral surface often dark scaled. *Terminalia.* (Figure 9 B) As in *aurantius*.

**MALE.** Similar to female in general habitus. *Head.* Antenna as in *aurantius*; torus bare, yellow-tan; palpus slightly longer than proboscis, segment I yellow scaled or yellow with dark scales scattered randomly, segment II yellow with apical 0.25 dark scaled, segment III all yellow scaled with apex dark, segment IV yellow with apical 0.25 dark and scattered dark scales along dorsum, segment V mottled, mainly yellow on basal half, dark on apical half, apex of segment III and all of segment IV with ventral hairs. *Legs.* As in female; tarsal claws as in *aurantius*. *Wing.* Scale fringe of alula mostly pale; wing scales generally lighter than in female. *Terminalia.* (Figure 12 B) The accessory lobe of the stem of the claspette as figured by Mattingly (1961: 35) is not as pronounced in all members, but is usually larger than in *aurantius*, and the filament is somewhat broader.

PUPA. (Figure 15 A) Trumpets long and narrow, pinna wider and dark, basal third tracheoid; index 6-10. *Cephalothorax*. Hairs 1-5-C bifid or trifold, 6-C small, triple, 7-C double, 8-C single or double, 9-C multiple, 10-C single, double, or triple, 11,12-C multiple. *Abdomen*. Hair 1-I multi-branched with branches plumose, 2-I single, 3-5-I multibranched, 6-I single or bifid; hair 1-II long, single; hair 1-VII double or bifid, 2-VII single, 3-VII double, 4-VII single, 5-VII double or triple, 6-VII small, multibranched, 7-VII small, multibranched, 9-VII with 2-4 branches, branches plumose, 10, 11-VII bifid or trifold; 4-VIII single or bifid, 9-VIII with 8-10 plumose branches. *Paddle*. Vaguely spiculate on lateral margin; hair 1-P long and single.

LARVA. (Figure 21) *Head*. Antenna vaguely spiculate, antennal tuft of 3-5 hairs at apical fifth; hairs 1,3-8-C single, 9-C double or triple, 10-C triple, 11-C double, 12,13-C with 3-5 branches; mentum with 13 teeth. *Thorax*. Hair 0-P small, multibranched, 1-P single, 2,3-P double, 4-P with 3-4 branches, 5-7-P single, 8-P with 6-8 branches, 9-P triple, 10-P single, 11-P small, double, 12-P single or double, 14-P single; hairs 1-3-M double, 4-M with 4 branches, 5-7-M single; hair 1-T single, 2-T with 4 branches, 3-T with 8 branches, 4-T small, 4-5 branched, 5-T single, 6-T triple. *Abdomen*. Hair 1-I single or double, 3-I triple, 6-I single, 7-I with 6 plumose branches, 9-I single or double, 10-I triple, 11-I small, multibranched, 12-I double, 13-I small, multibranched; hair 1-VII double or triple, 2-VII single, 3-VII triple, 4-VII single or double, 7-VII single, 9-VII double or triple, 10-VII with 3-5 branches, 11-VII single or double, 12-VII double, 13-VII triple; hair 2-VIII double, 4-VIII single; comb scales over 50, usually over 60; siphon with well developed acus, siphonal tuft well beyond middle, of 11-15 plumose branches; pecten with apical 2 teeth displaced, apical tooth usually entire and surpassing the siphonal tuft, other pecten teeth with 1-3 lateral teeth; saddle incomplete, dorsal apical edge without spines, hair 1-X long and single; ventral brush of 22-25 tufts, each with 9-11 branches; anal papillae short.

TYPE DATA. Holotype ♀, Parang, Cotabato, *Mindanao*, PHILIPPINES, 26-X-, Page, in the U.S. National Museum.

DISTRIBUTION. This species is restricted to the PHILIPPINES. Material examined: 16♂♂, 12♀♀, 2 larvae, 26 larval skins, and 26 pupal skins as follows: *Leyte*, Tacloban, 14♂♂, 7♀♀ with associated skins, 4 unassociated larval and pupal skins, and 2 whole larvae, 25-IX-1945, H. Roberts; *Leyte*, Carigara, 1♂, 10-XI-1944, E.S. Ross; *Palawan*, Panakan, 1♂, 4♀♀ with associated skins, 29-XI-1967; *Tawi Tawi*, Tarawakan, 1♀, -IV-1967, M. Delfinado; same data, 1♀, 12-XI-1961.

TAXONOMIC DISCUSSION. This form is similar to *aurantius* and many have felt it should remain a subspecies of *aurantius* as placed by Edwards (he used the term variety). Because of the differences found in the adult and the pupal forms, and the distinct ranges of each, I prefer to leave *quadripunctis* as a distinct species.

The adults differ in having the integument reddish-brown and the abdominal tergites and scutum covered with yellow-copper colored scales (mainly copper-brown in *painei* and *aurantius*). The larvae cannot be separated on any non-varying characters. The larvae of *aurantius*, *painei* and *quadripunctis* are all very similar and at this time are best separated by distribution alone. The pupae are also similar but differ in having the lateral edges of the paddles vaguely spiculate in *quadripunctis*, densely so in *painei* and *aurantius* (See Figure 15).

BIOLOGY. Knight records the larvae from rain filled temporary puddles. Material on hand from Palawan was taken from the same locality, and perhaps the same pool, as the *laniger* material.

## ACKNOWLEDGEMENTS

I wish to thank Dr. Botha de Meillon, Project Leader, Southeast Asia Mosquito Project, Dr. Alan Stone, Agriculture Research Service, U.S. Department of Agriculture, and Dr. K. L. Knight, Department of Entomology, North Carolina State College, for their help and useful criticisms during the course of the study and the preparation of the manuscript. Special thanks to Dr. P. F. Mattingly, British Museum of Natural History, who examined the cotypes of, and selected a lectotype of *Ae. scatophagoides* for me. The loan of various specimens obtained for me by SEAMP from Dr. Mattingly, Dr. J. N. Belkin, Department of Entomology, University of California at Los Angeles; the Director, Office de la Recherche Scientifique et Technique Outre Mer, Paris, France; The Director, South African Institute for Medical Research, Johannesburg; and Dr. P. Konfortion, Medical and Health Department, Regent, Mauritius, are acknowledged with thanks.<sup>1</sup> The illustrators of the 406th Medical Laboratory, Japan, and Mrs. Elaine Hodges of SEAMP are acknowledged for their beautiful and invaluable work, and the curator and technicians of SEAMP for their detailed work and technical assistance. My personal thanks to E. L. Peyton for always making himself available for advice.

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<sup>1</sup> Figure 9-C was reproduced with the consent of the Editor, Journal of the Entomological Society of Southern Africa.



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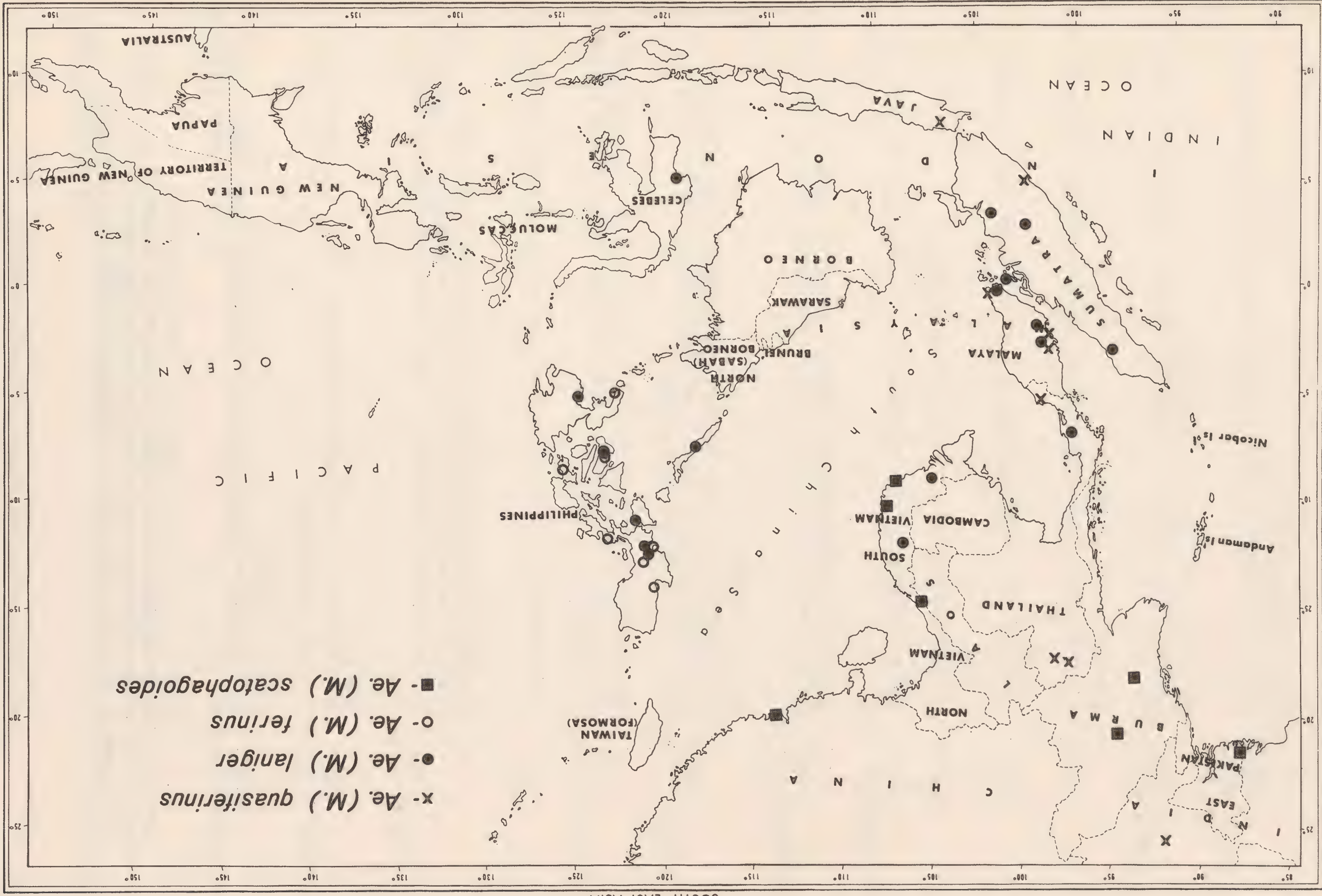
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# GROUP A MUCIDUS

SOUTH-EAST ASIA

- x- Ae. (M.) *quasiferinus*
- Ae. (M.) *laniger*
- Ae. (M.) *ferinus*
- Ae. (M.) *scatophagoides*



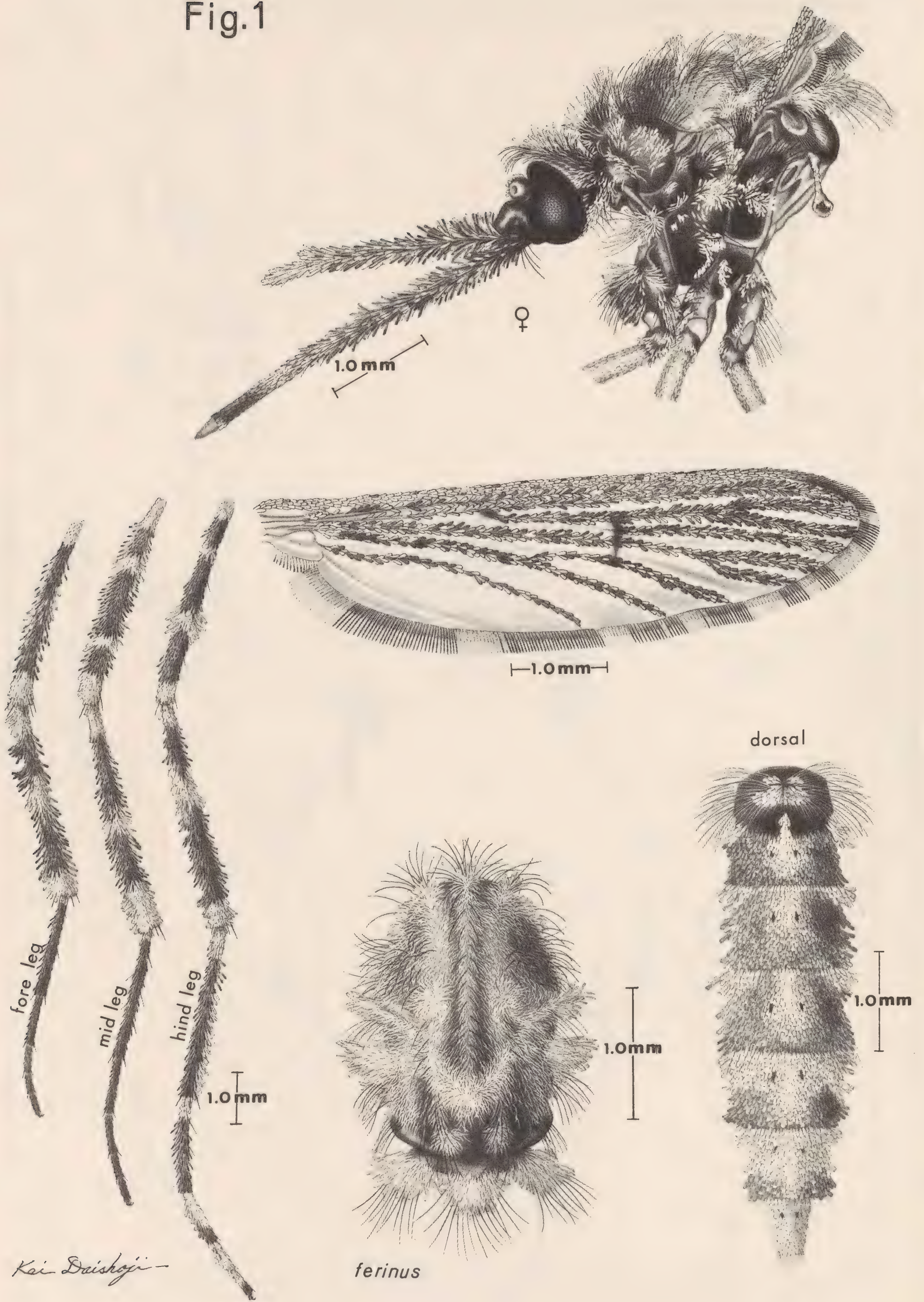
# GROUP B PARDOMYIA

SOUTH-EAST ASIA

○-Ae. (M.) *aurantius*  
●-Ae. (M.) *quadripunctis*



Fig.1



♀

1.0mm

1.0mm

dorsal

fore leg

mid leg

hind leg

1.0mm

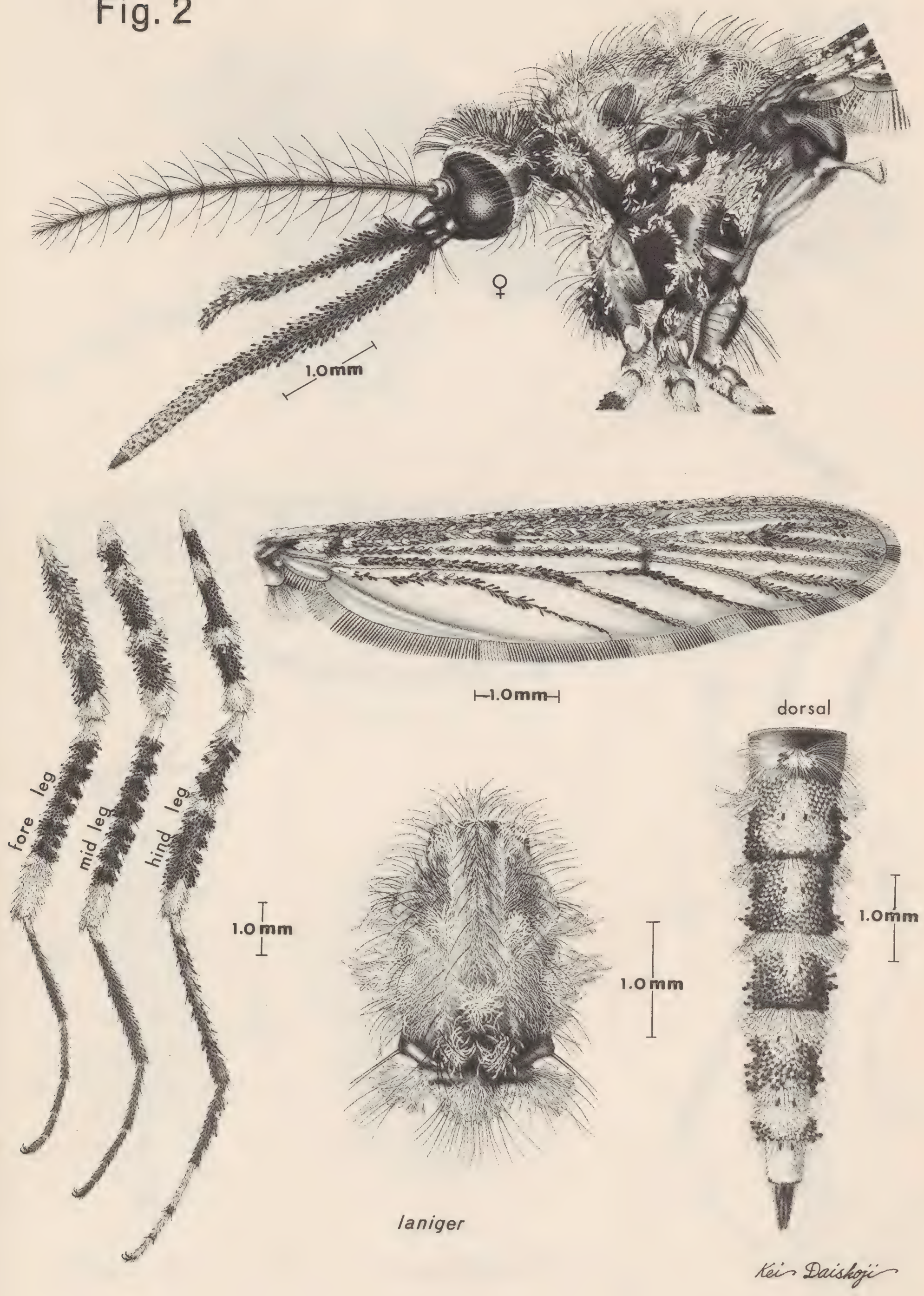
1.0mm

1.0mm

*Kai Daishoji*

*ferinus*

Fig. 2



♀

1.0mm

1.0mm

fore leg

mid leg

hind leg

1.0mm

laniger

1.0mm

dorsal

1.0mm

Kei Daiskoji



Fig. 3

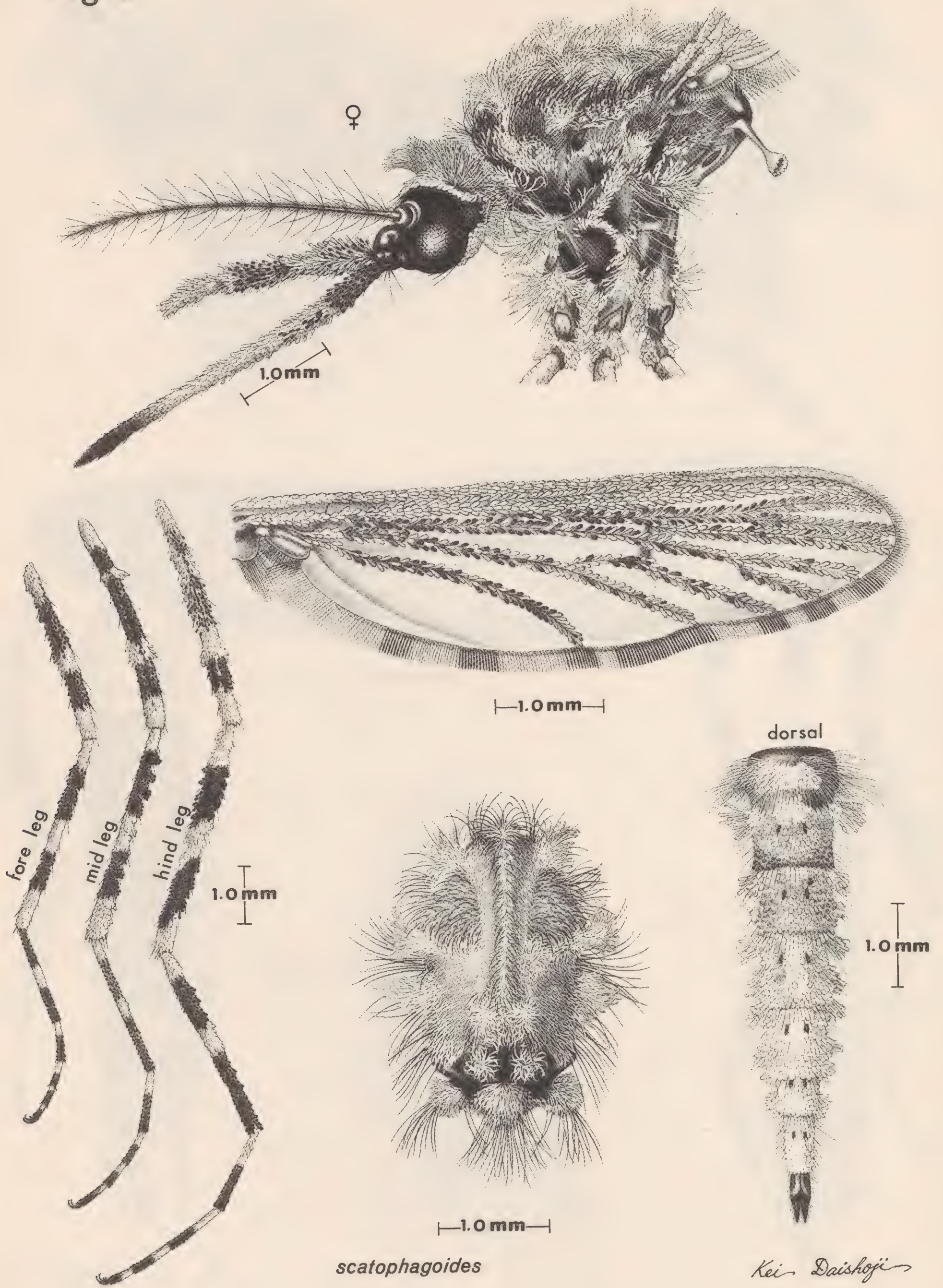
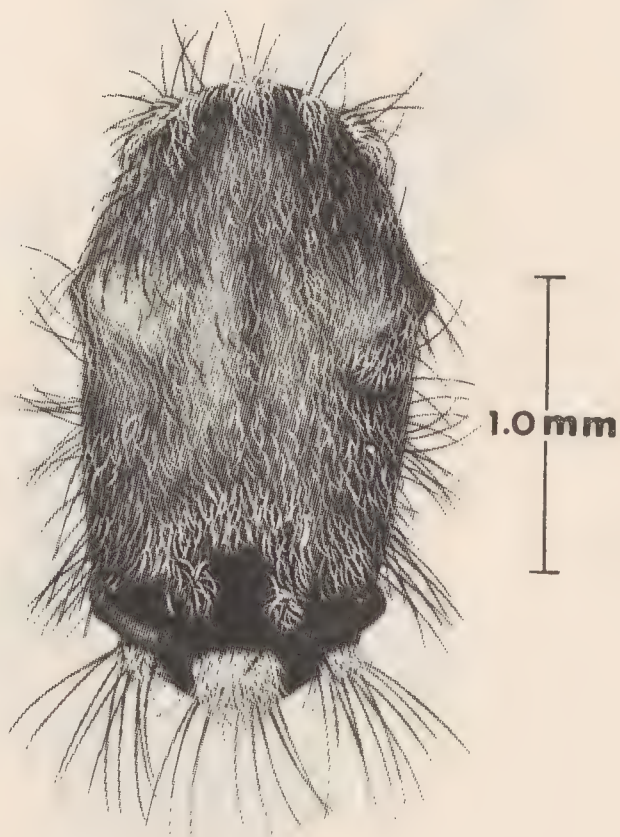
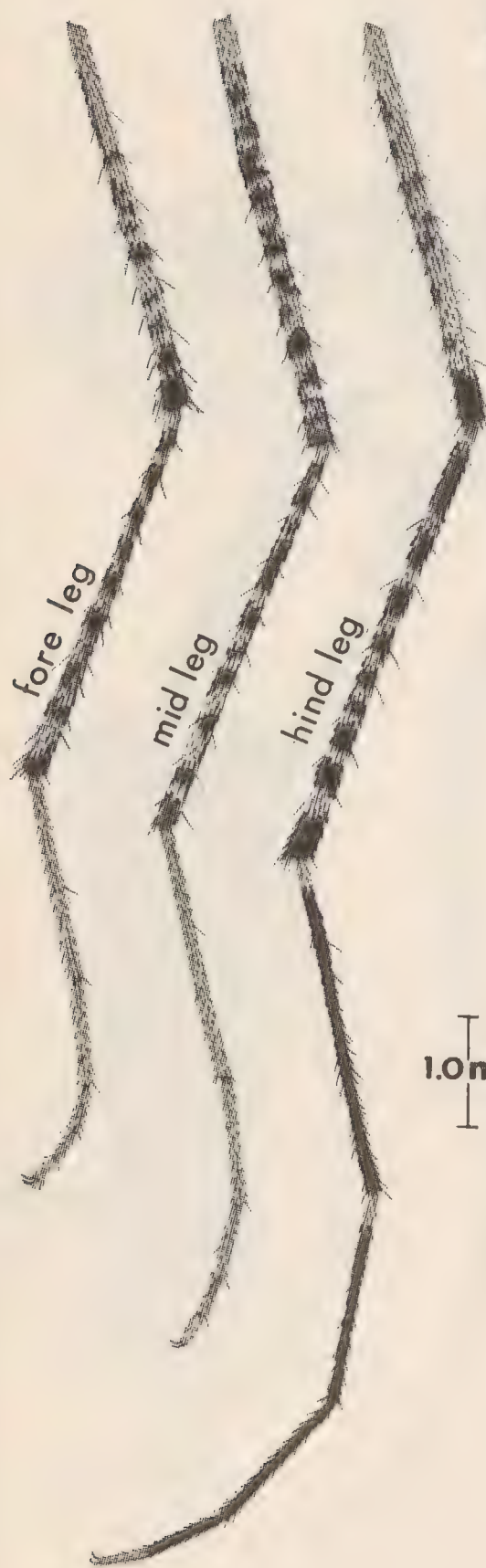


Fig.4



*quadripunctis*

Fujisawa  
69

Fig.5

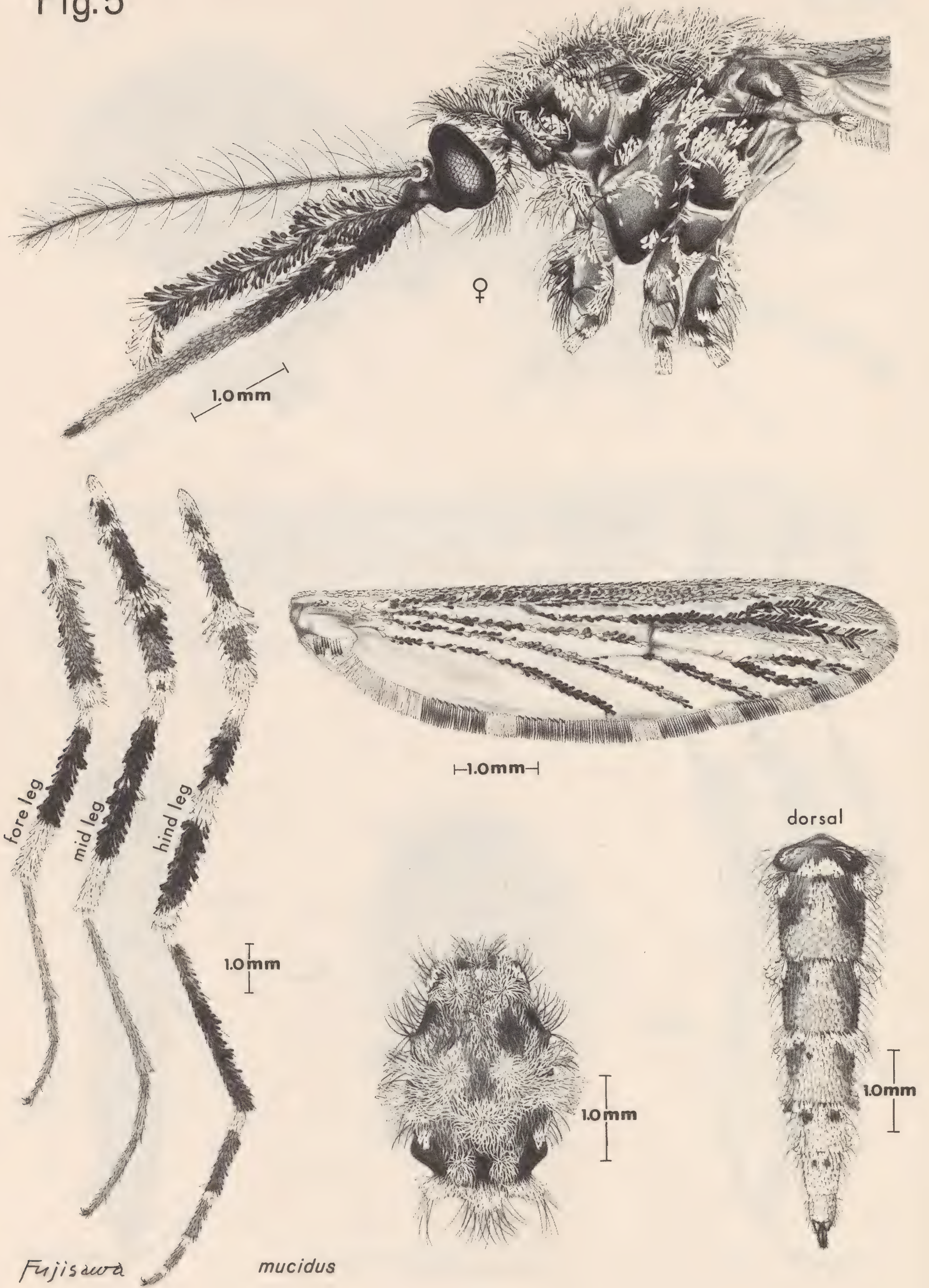


Fig. 6

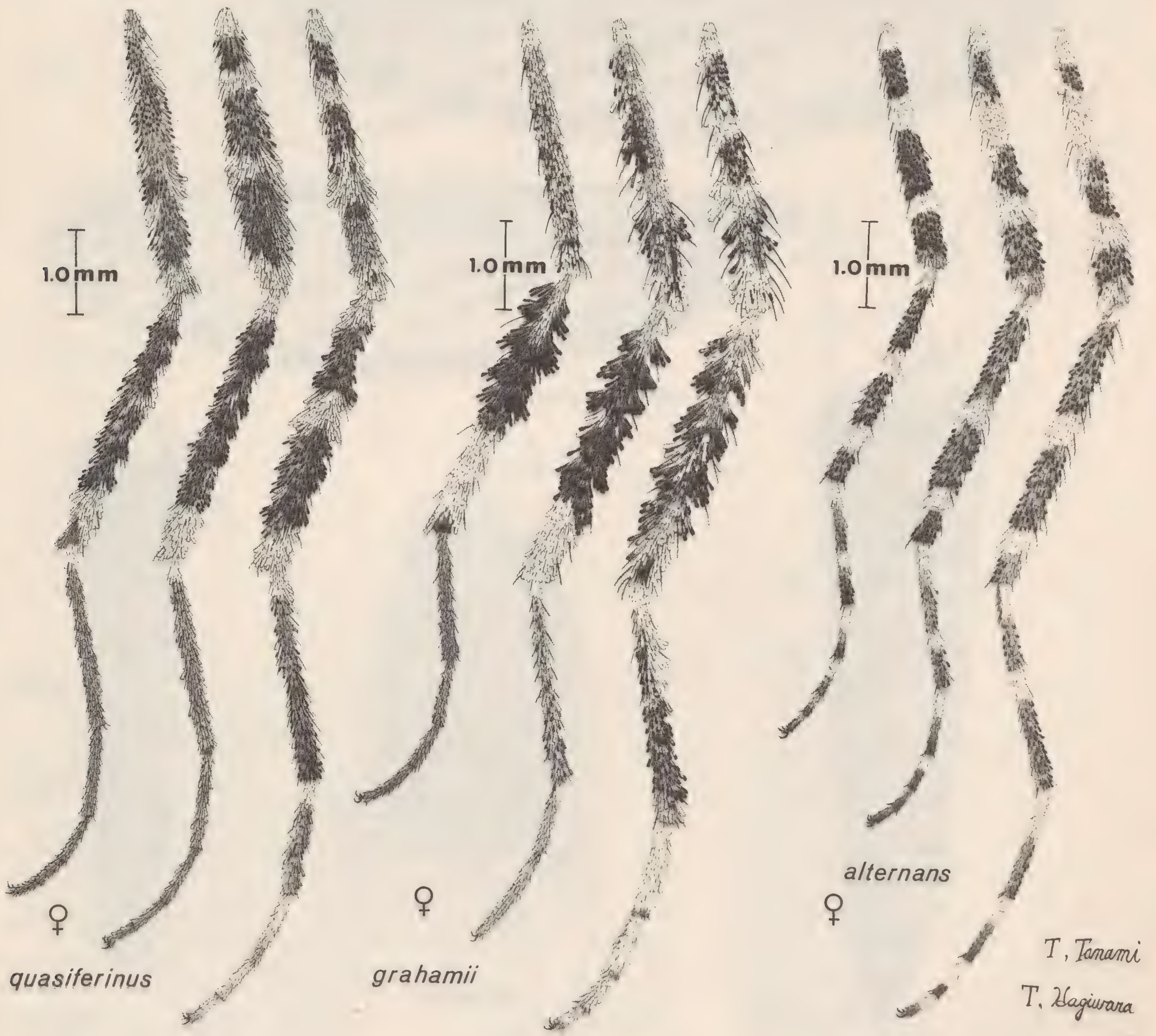
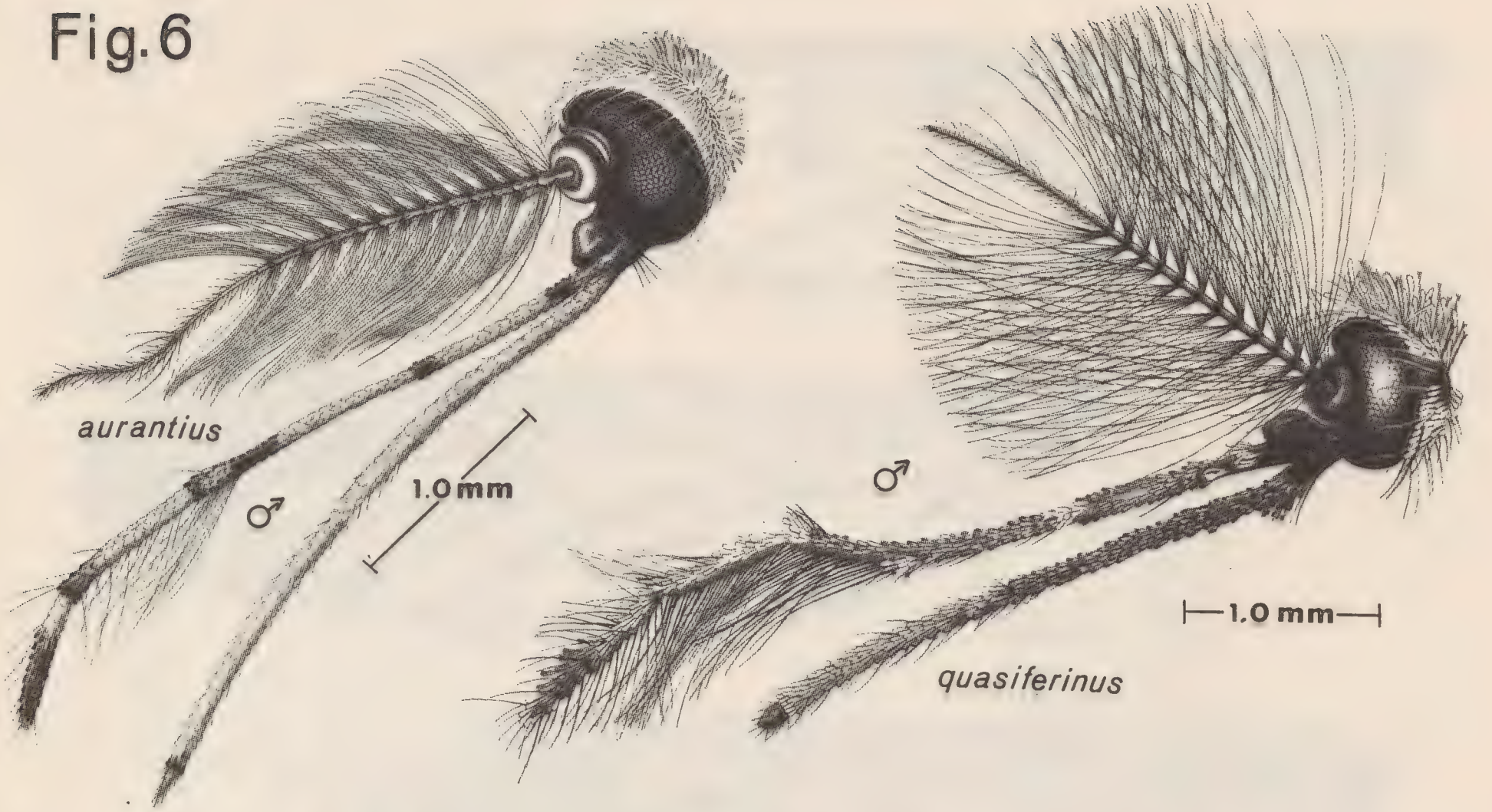
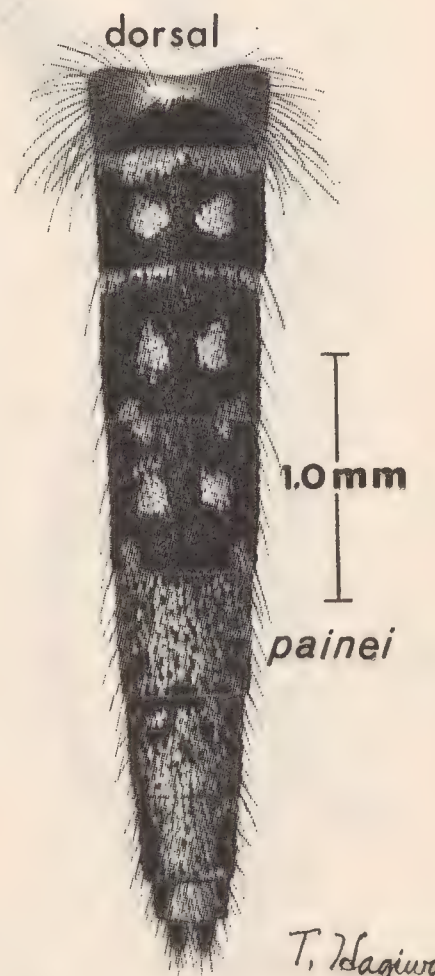
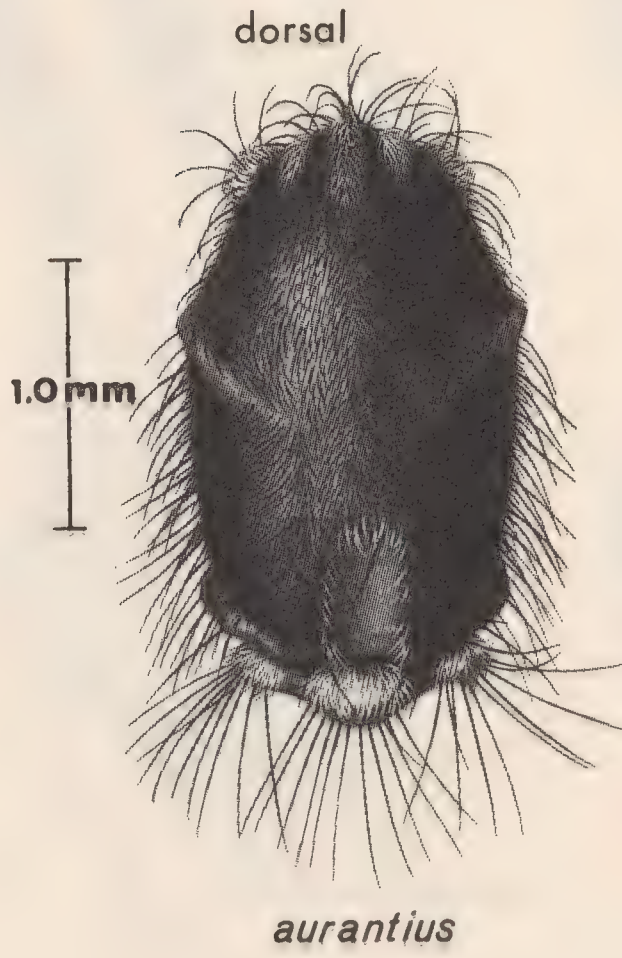
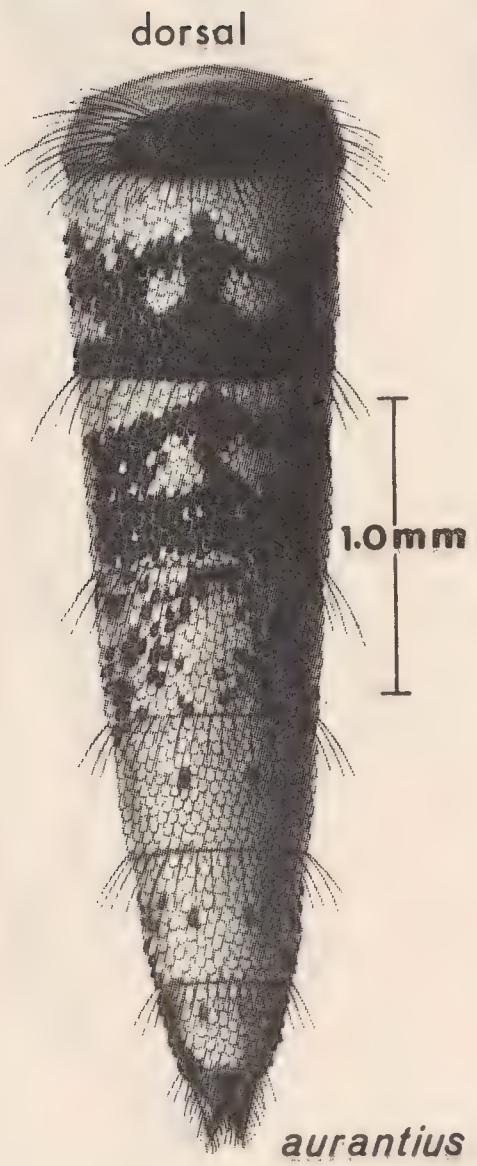
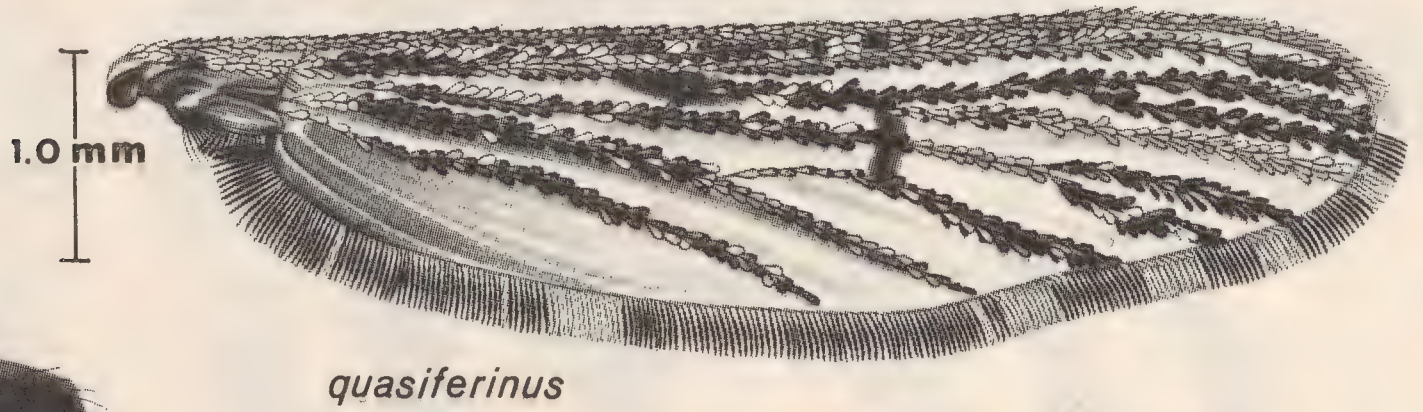
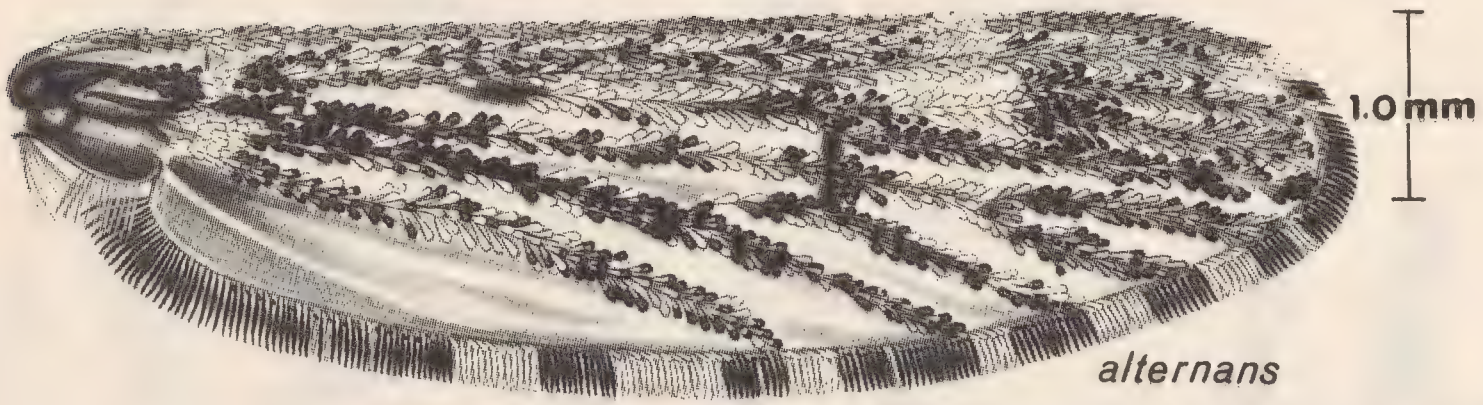
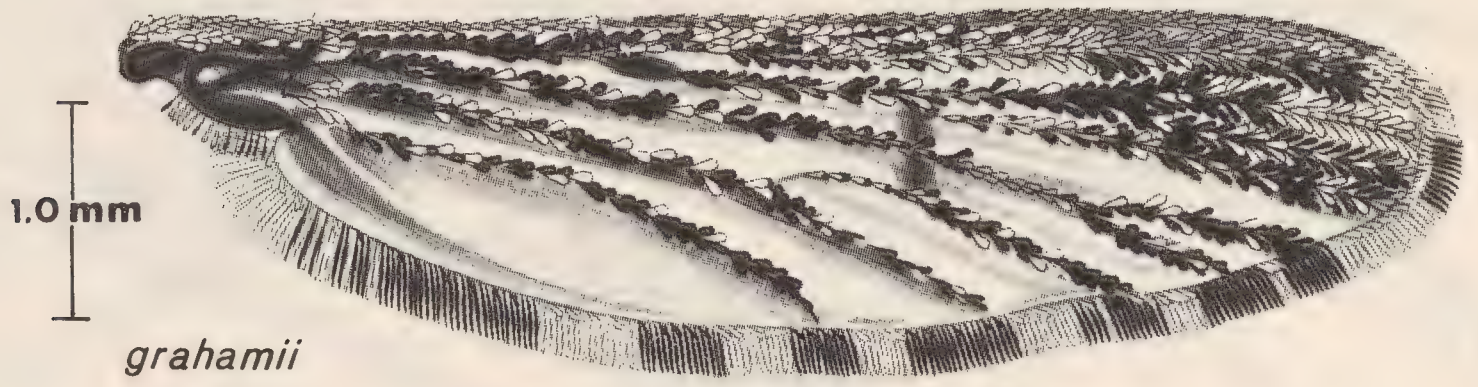
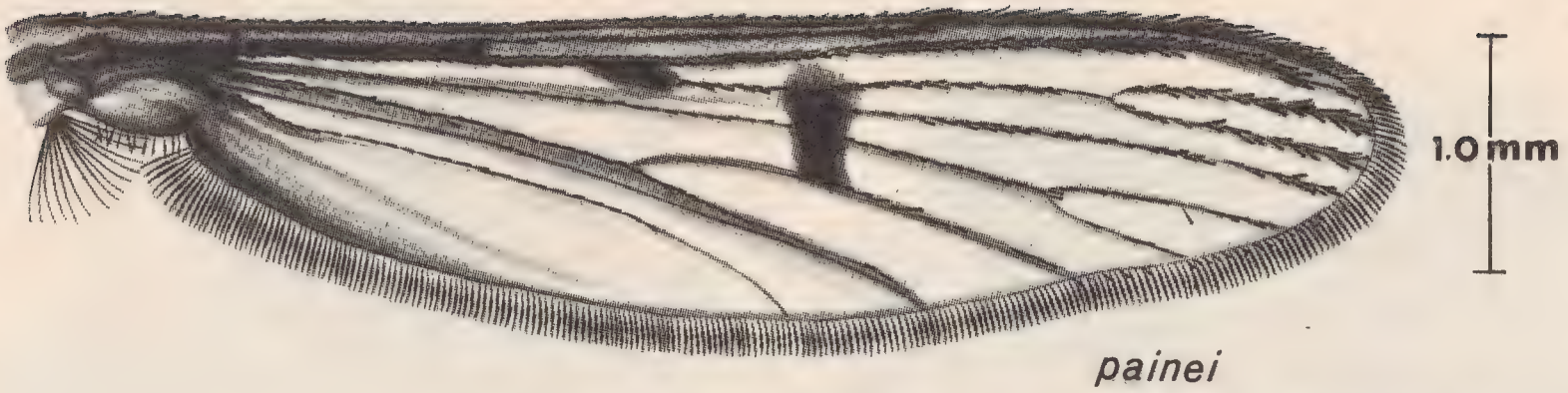
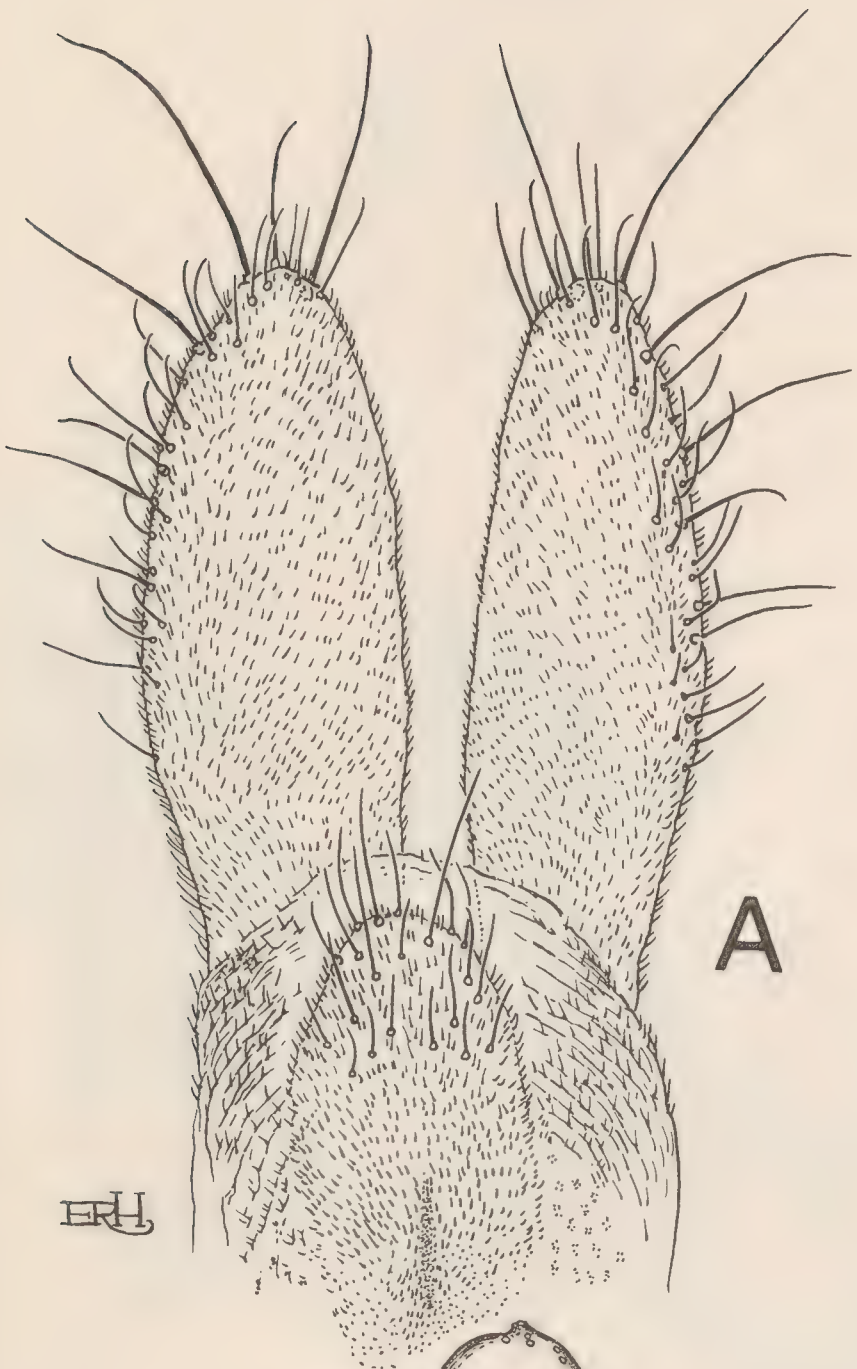


Fig. 7



T. Hagiwara  
Kei Daikoji

Fig. 8

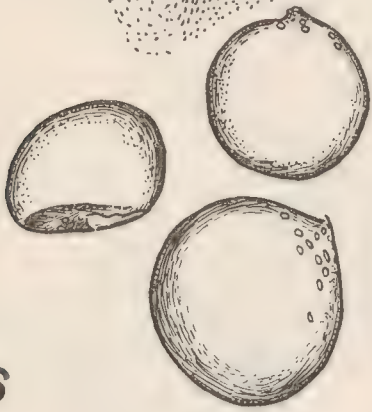


A

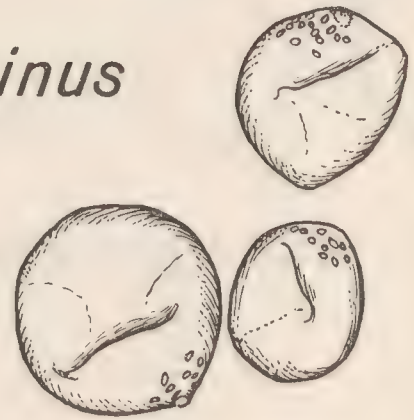


B

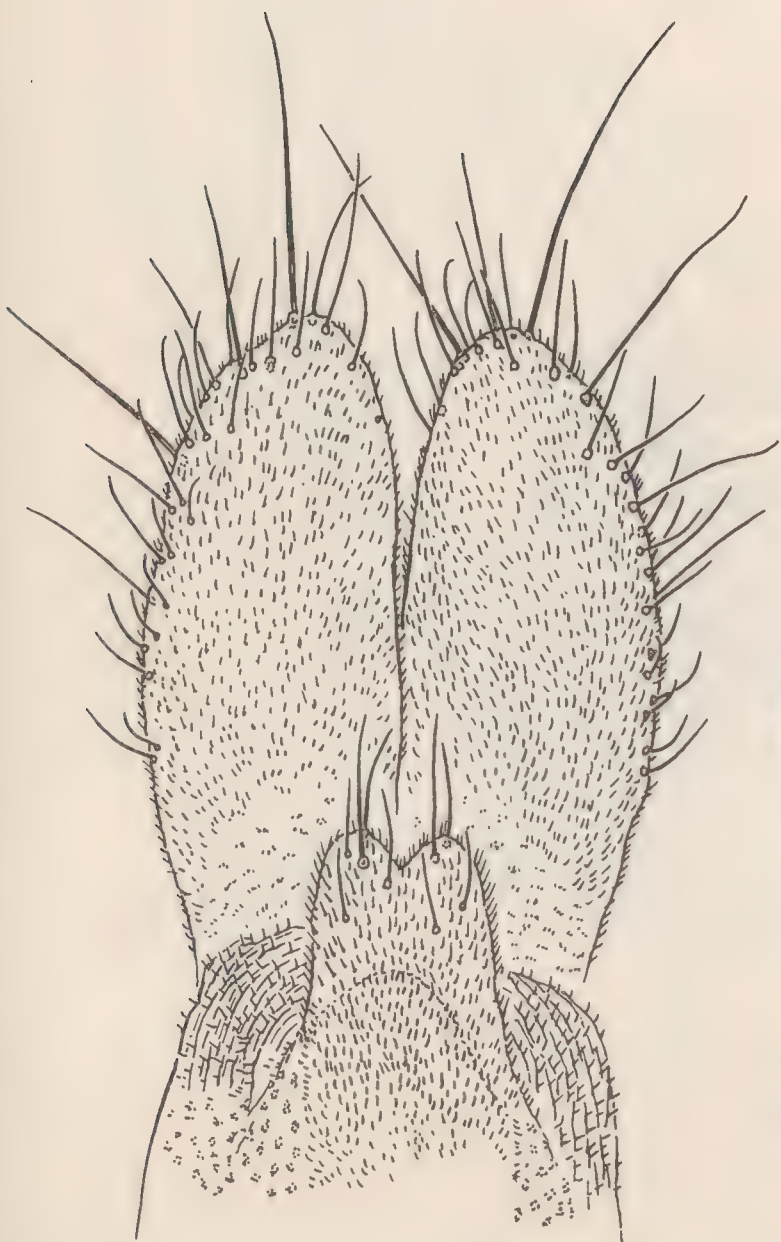
*ferinus*



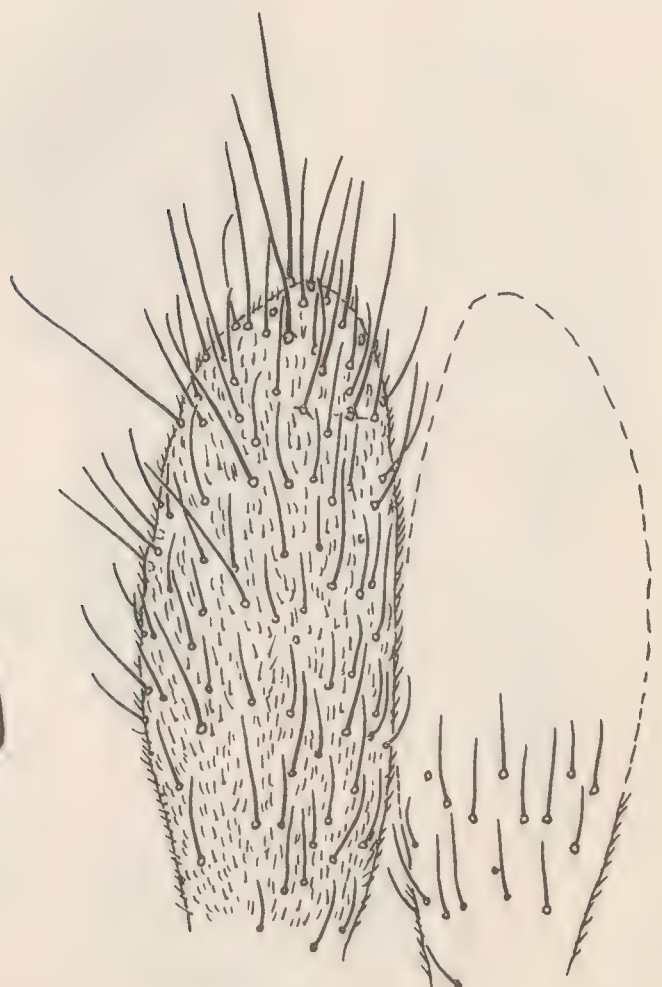
*quasiferinus*



C

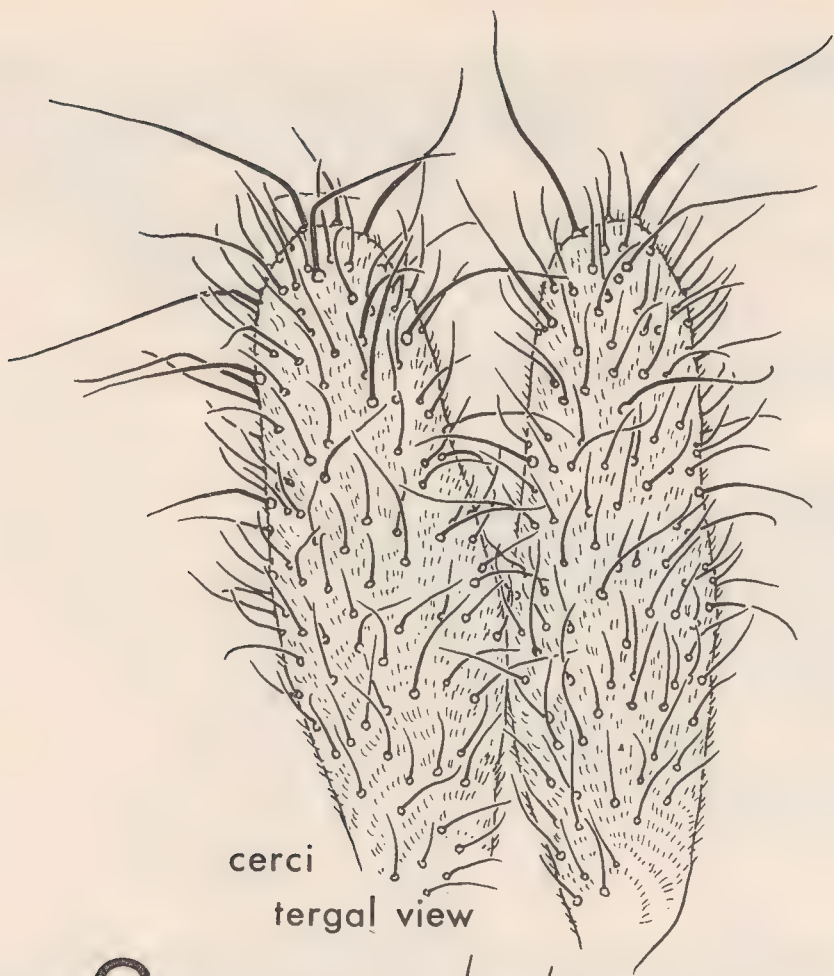


*laniger*



tergal view  
*laniger*

Fig. 9



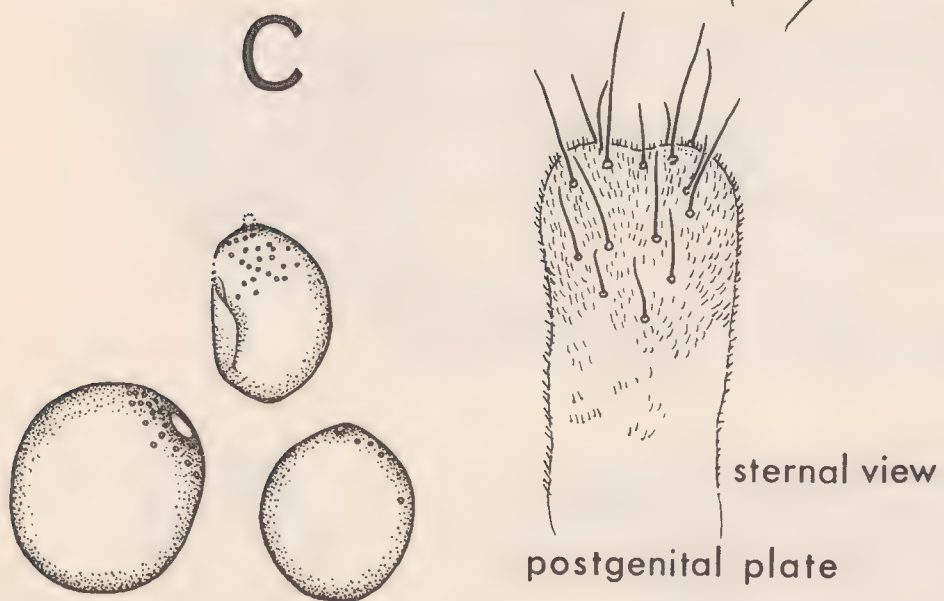
cerci  
tergal view



B



*quadripunctis*

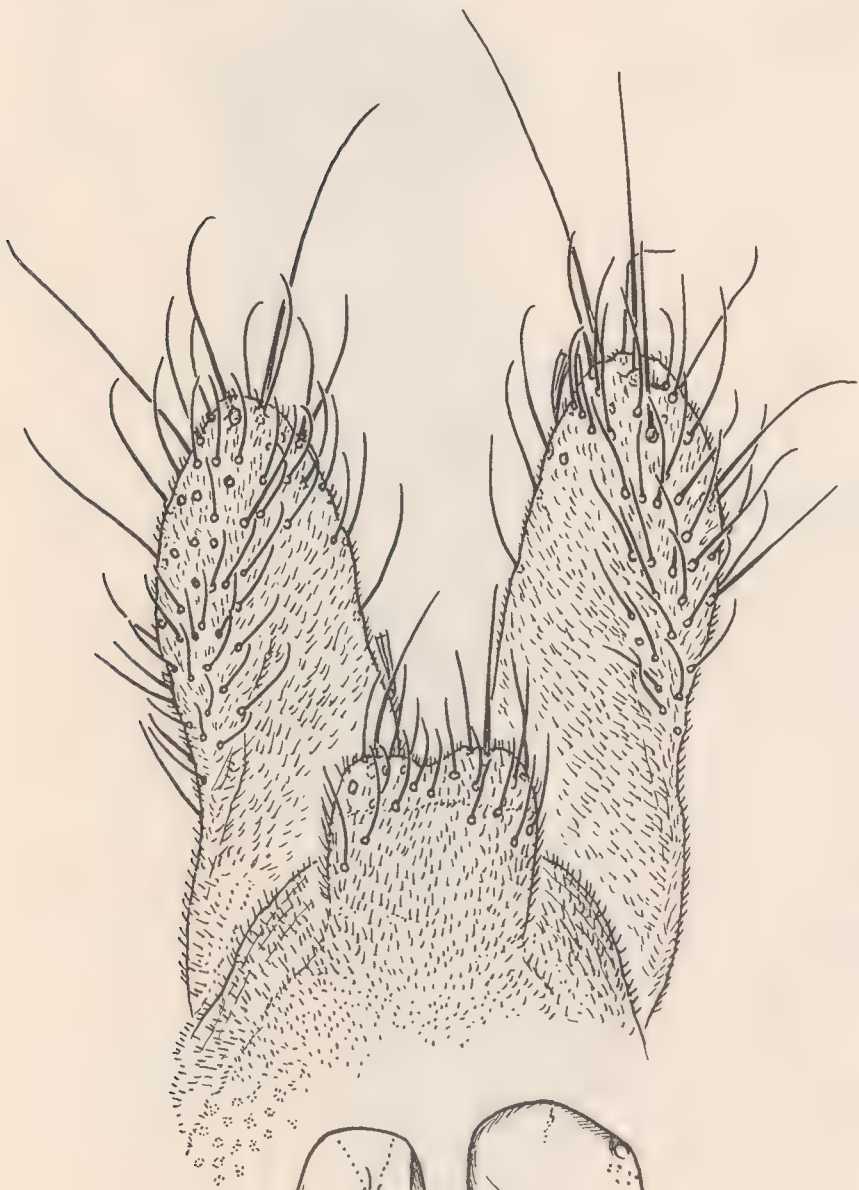


sternal view

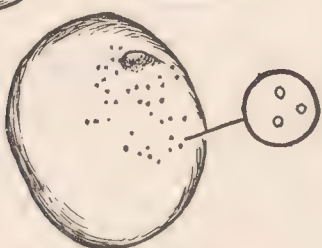
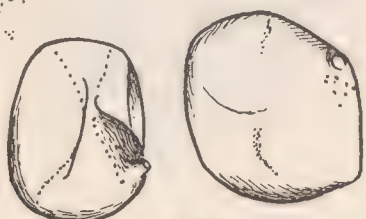
postgenital plate



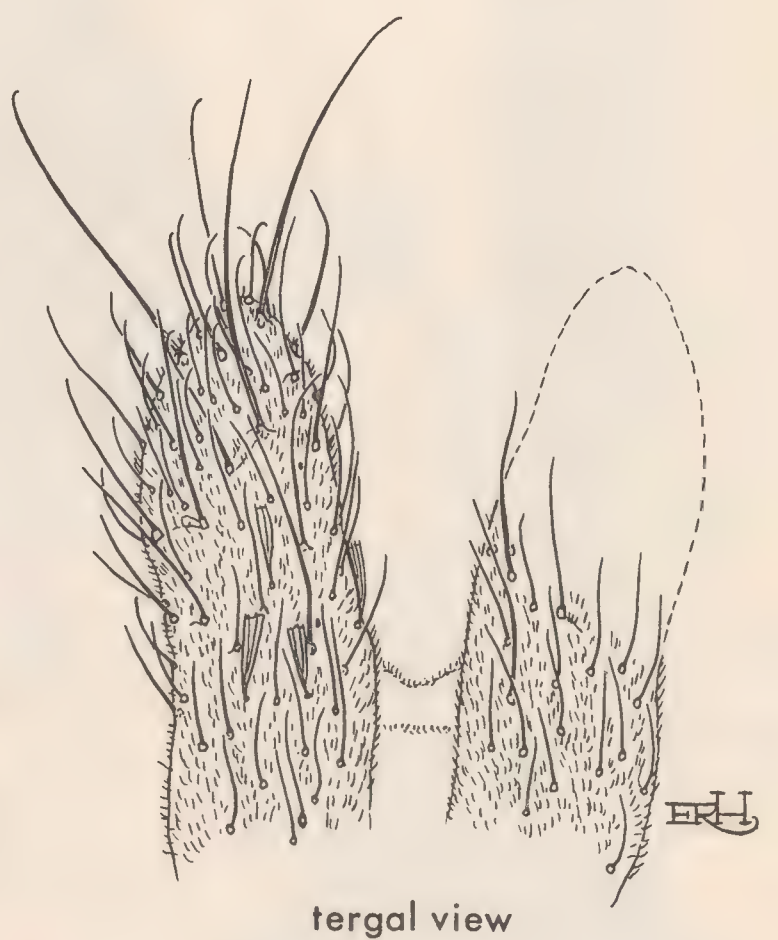
*scatophagoides*



A



*aurantius*



tergal view

Fig. 10

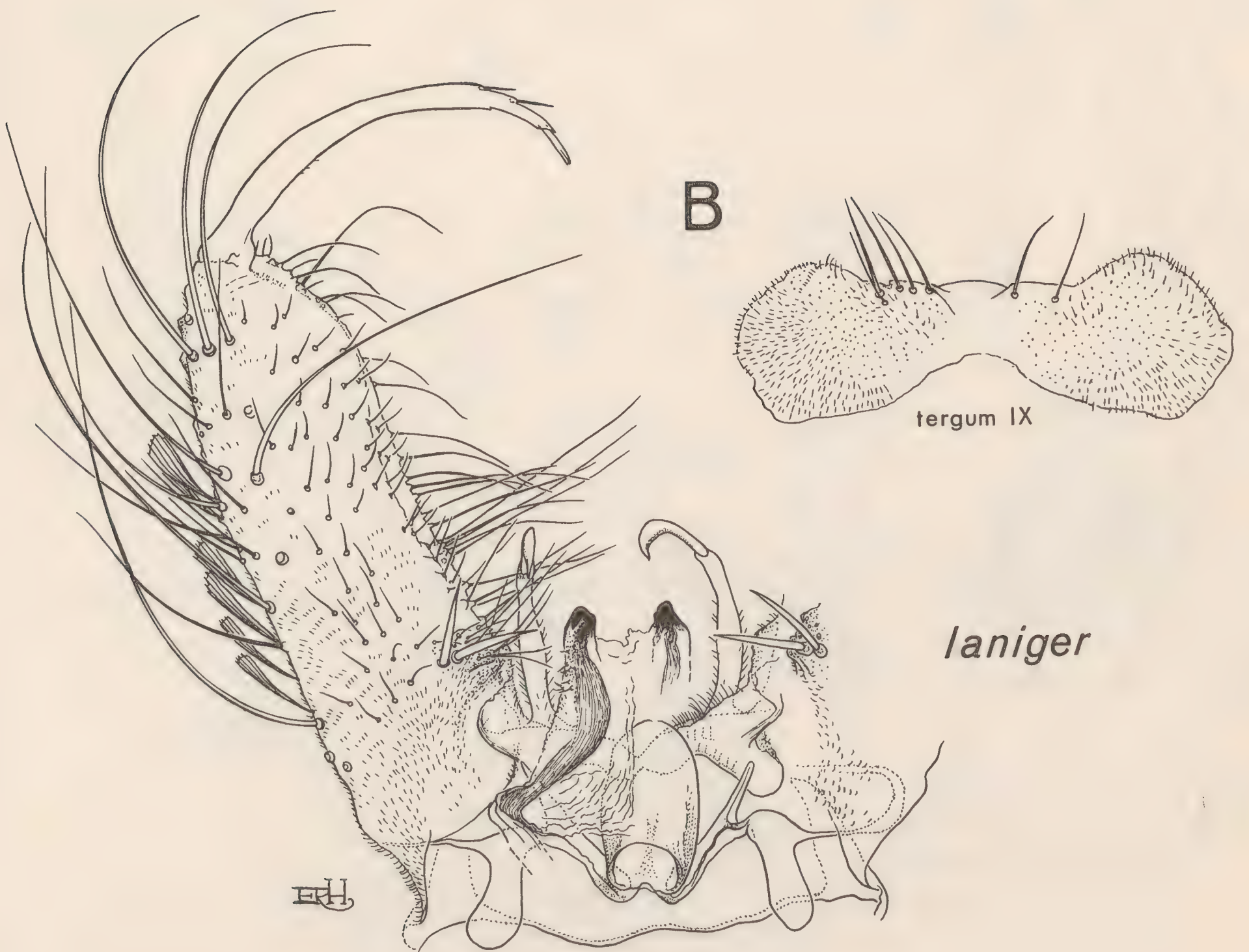
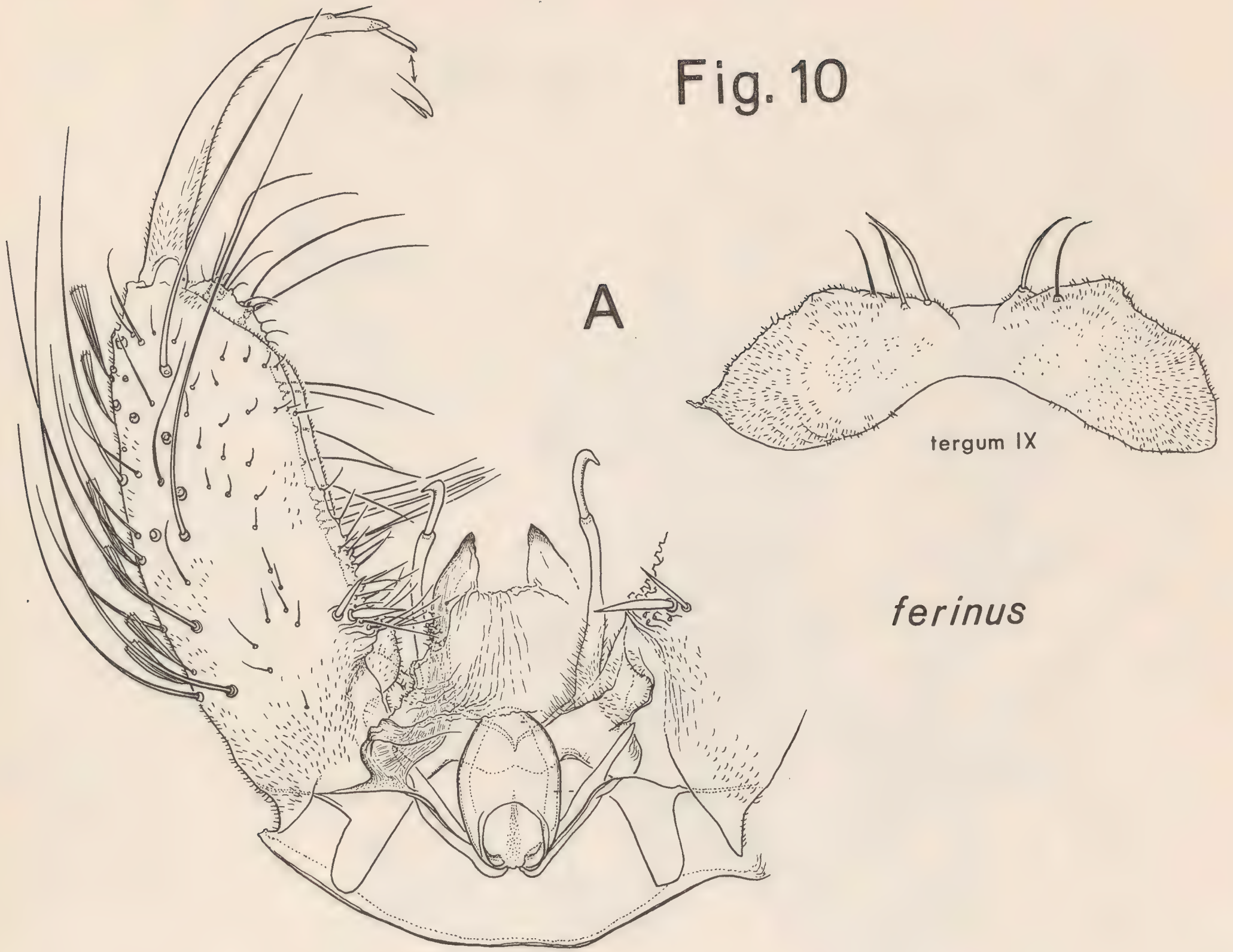
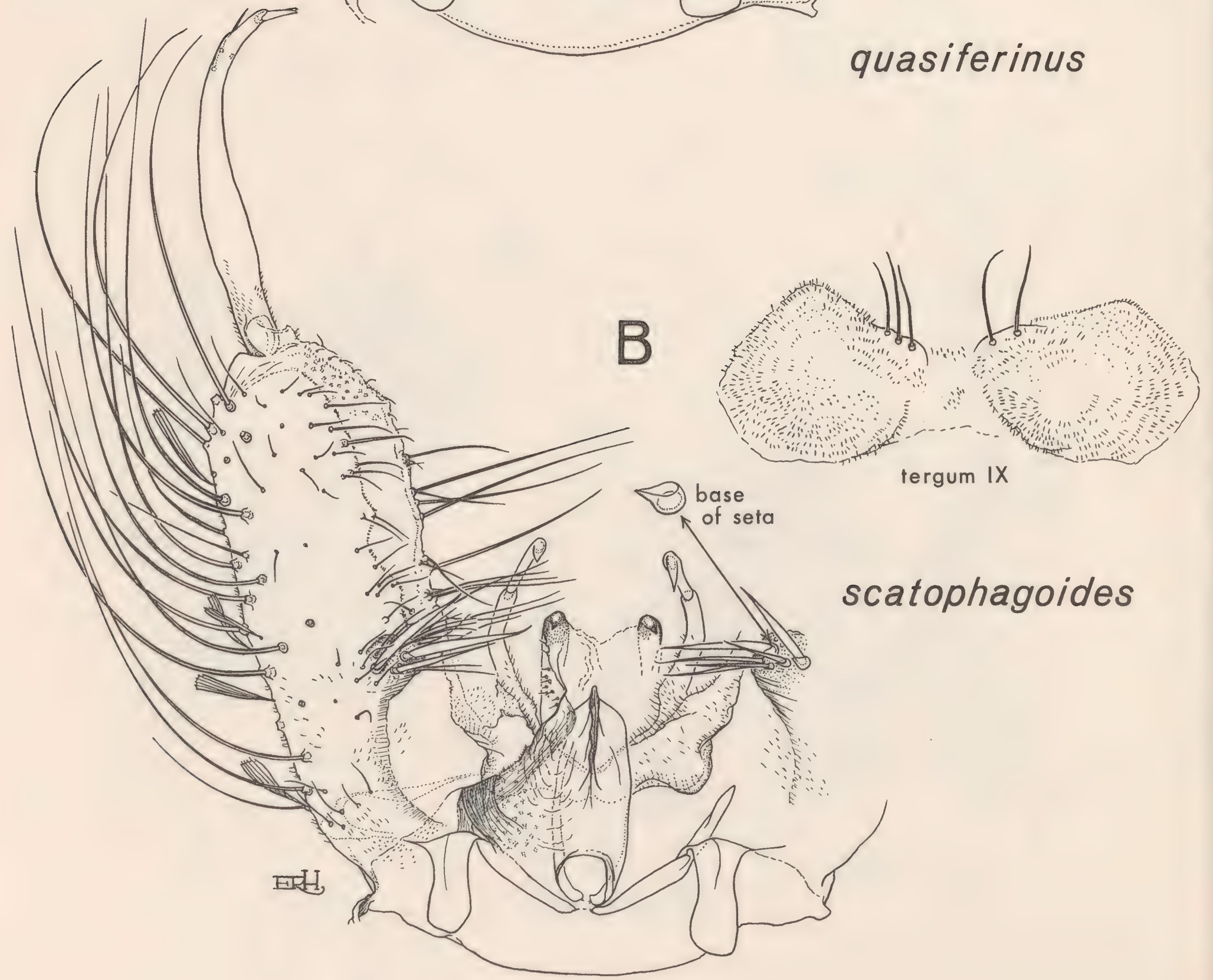
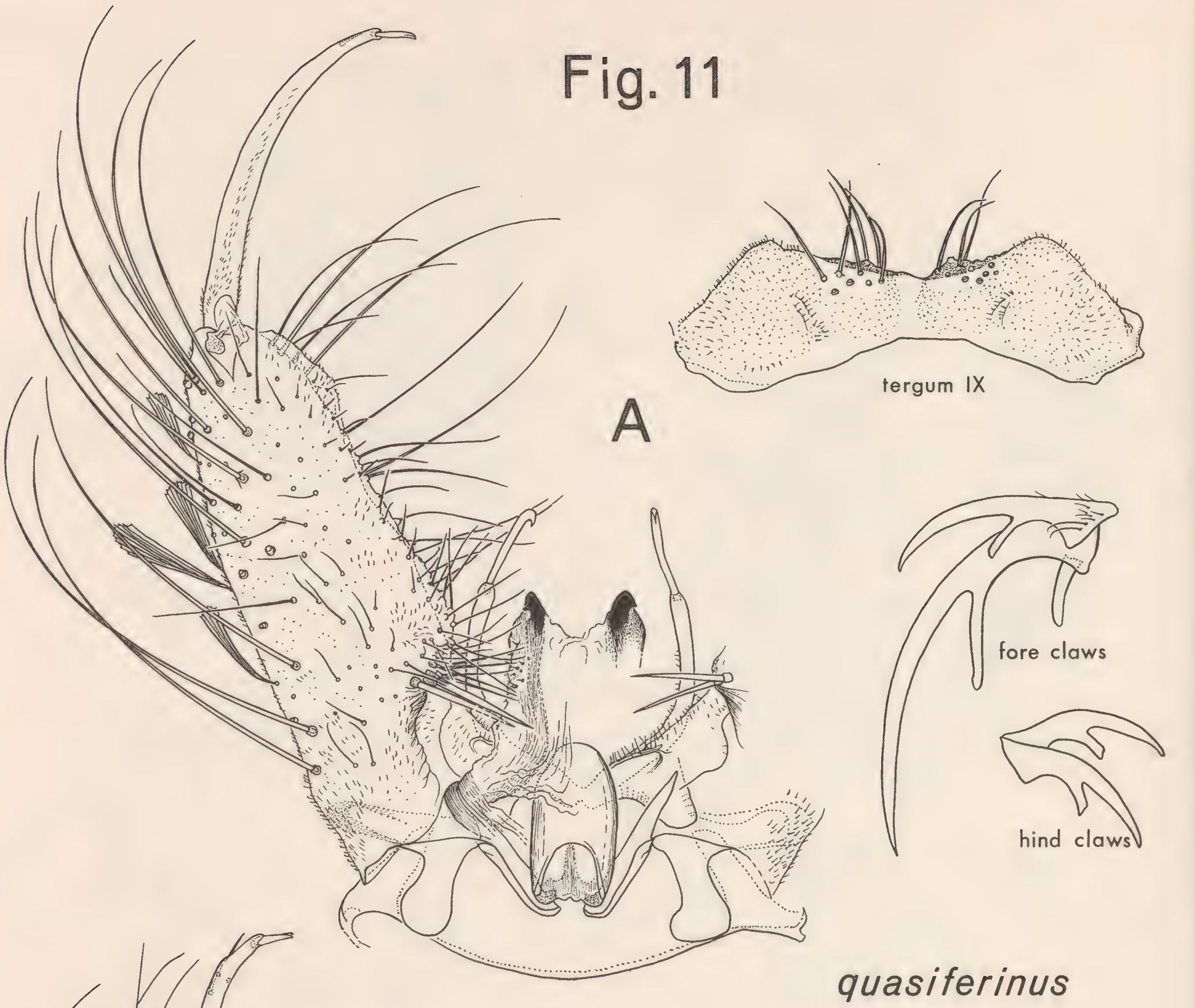




Fig. 11



EH

Fig. 12

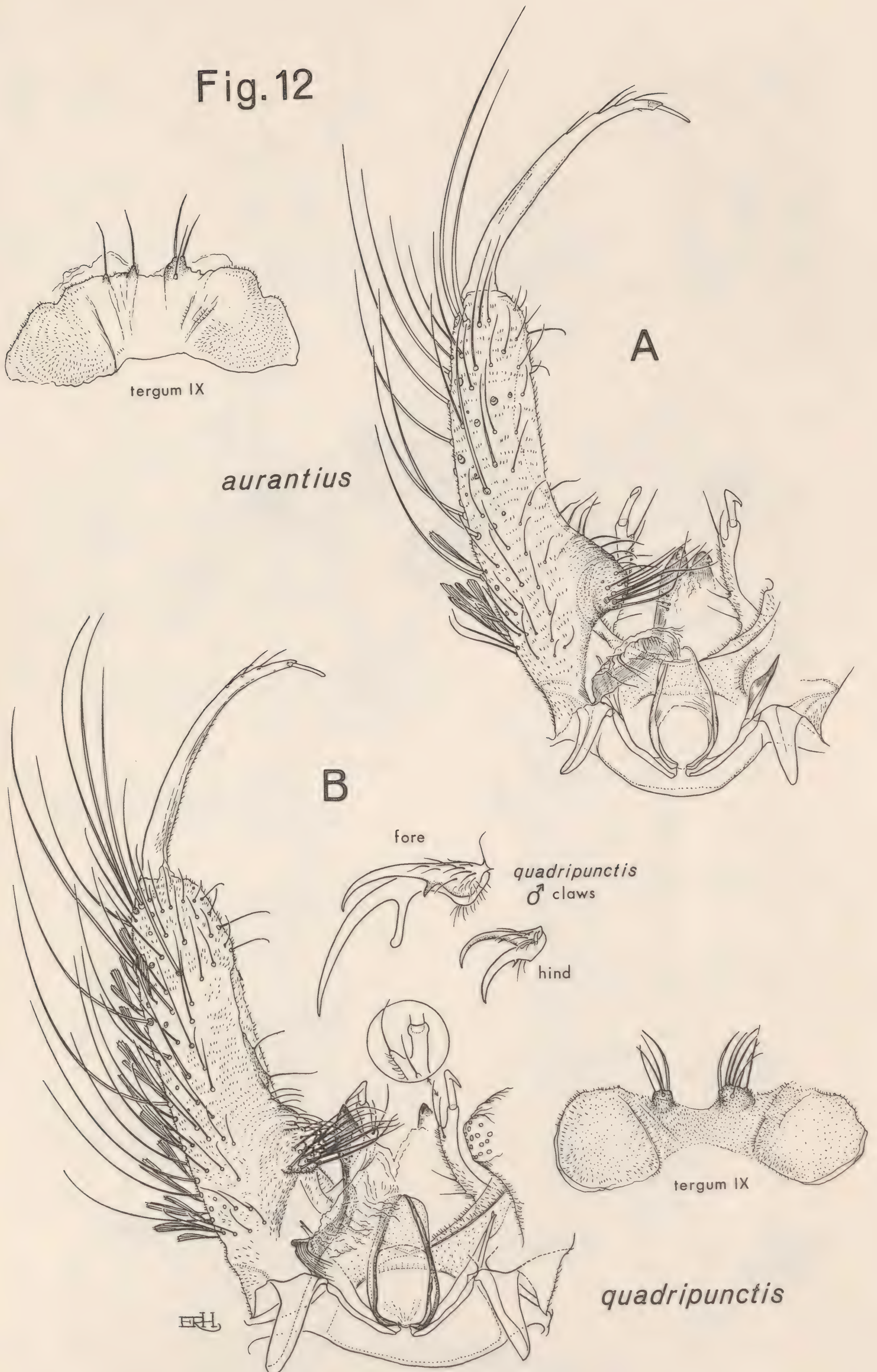


Fig. 13

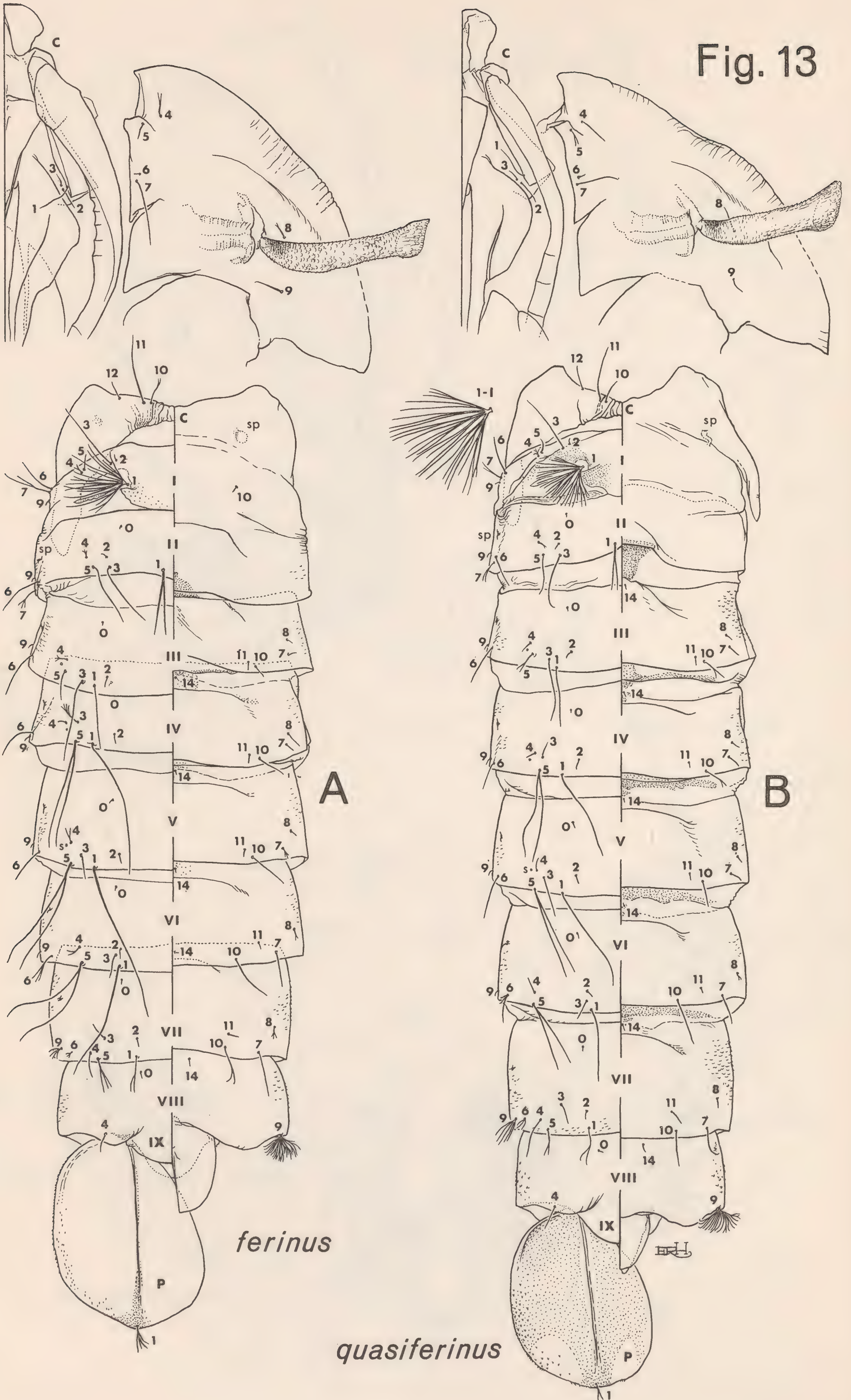


Fig. 14

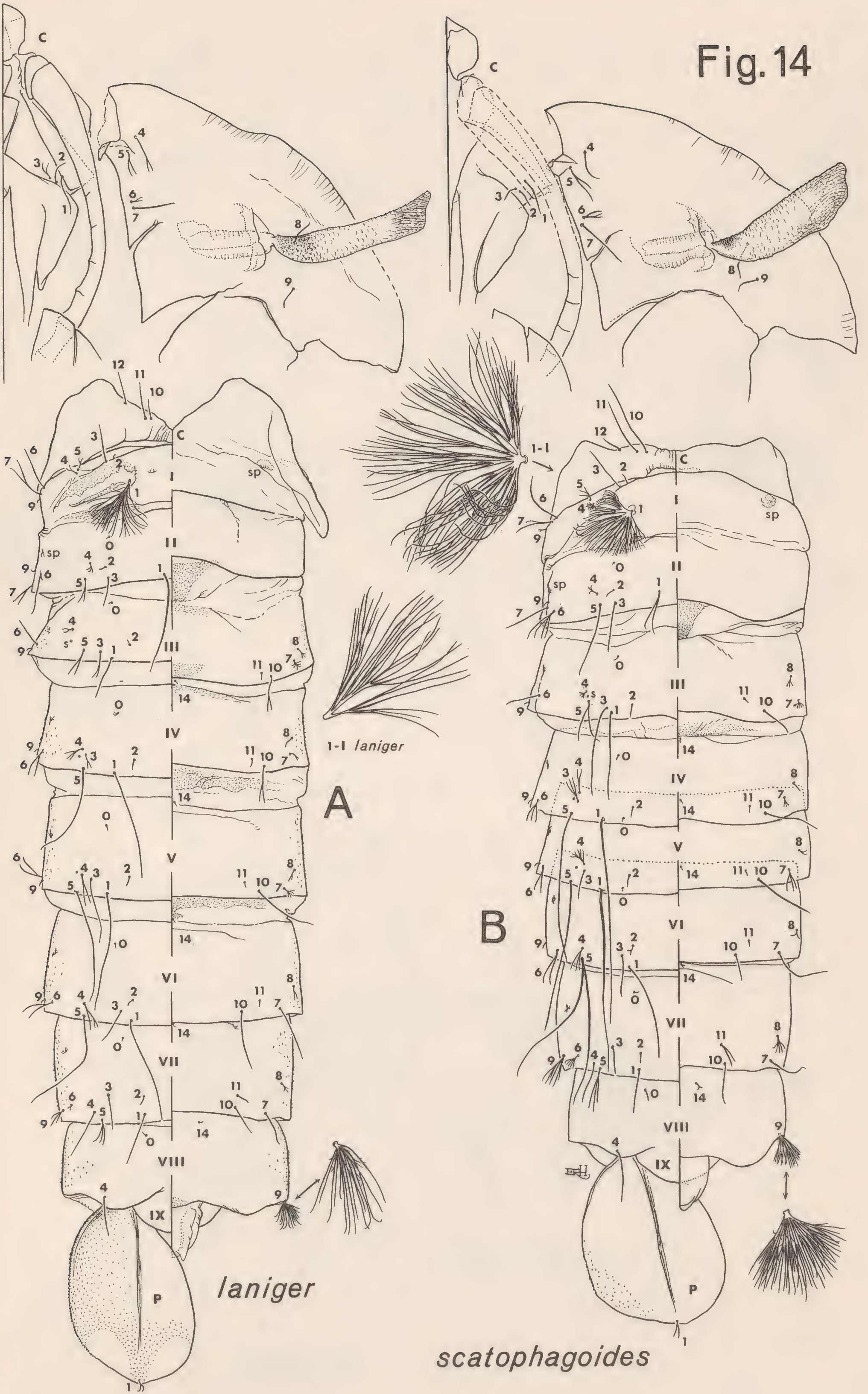


Fig. 15

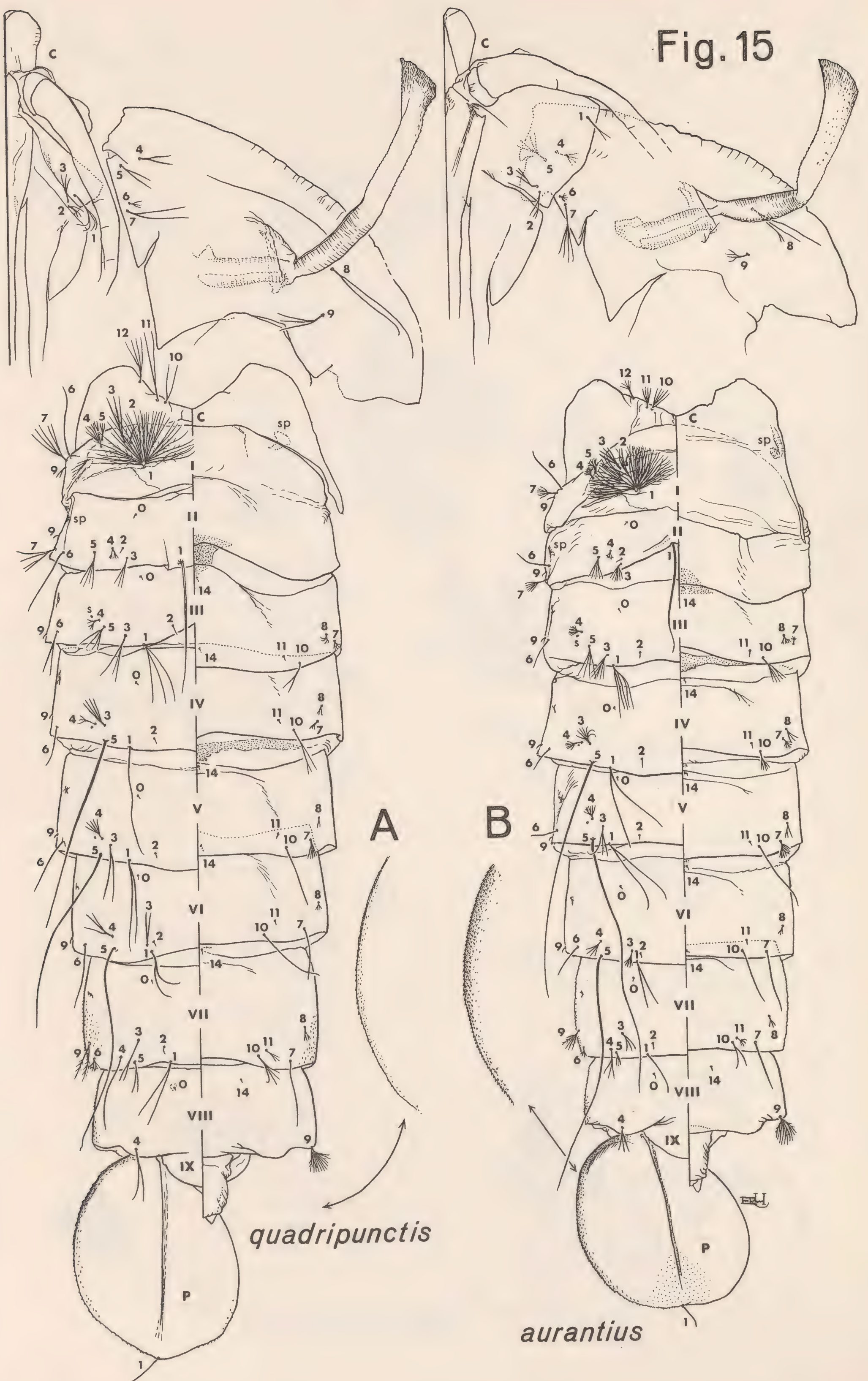
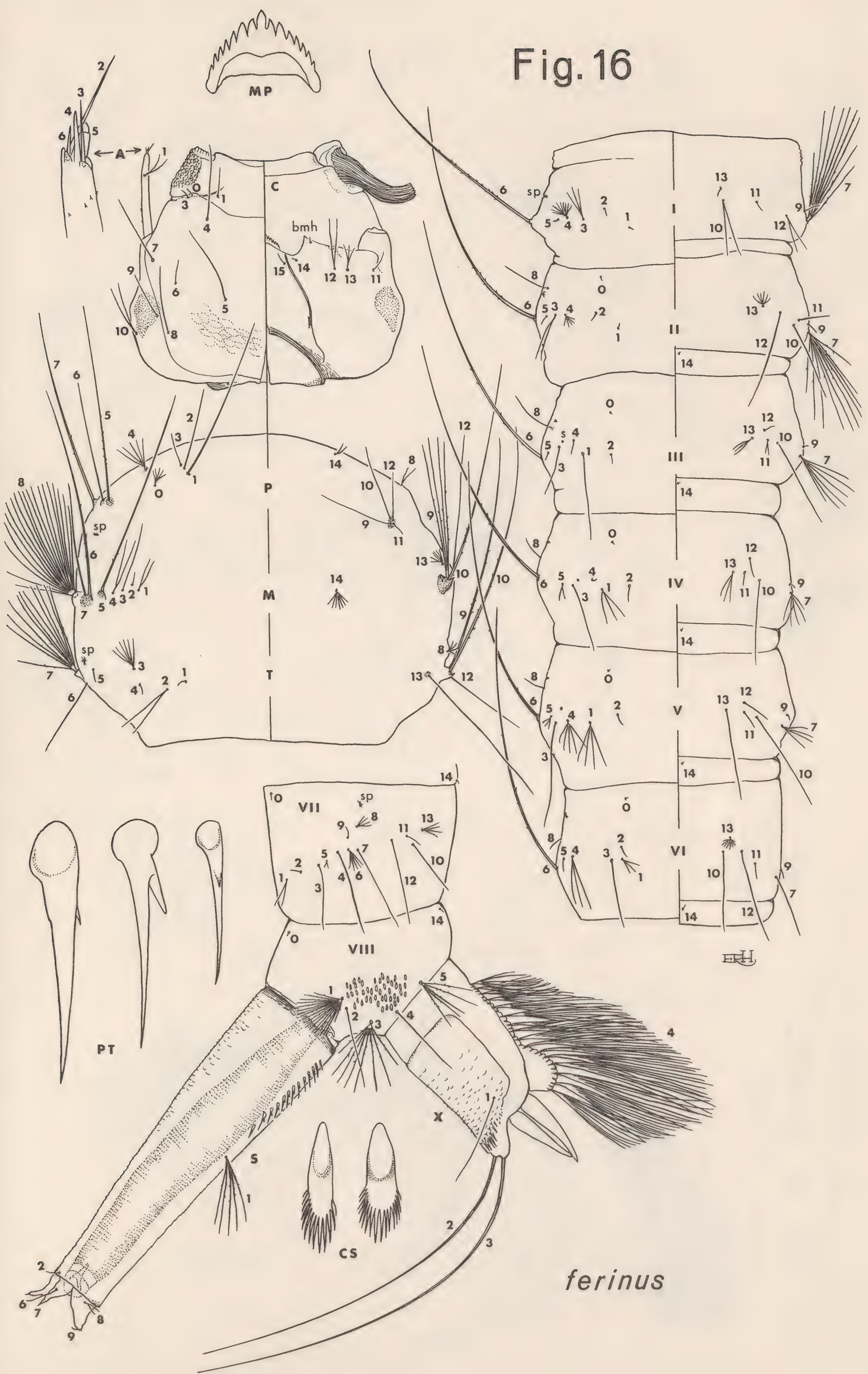


Fig. 16



*ferinus*



Fig. 18

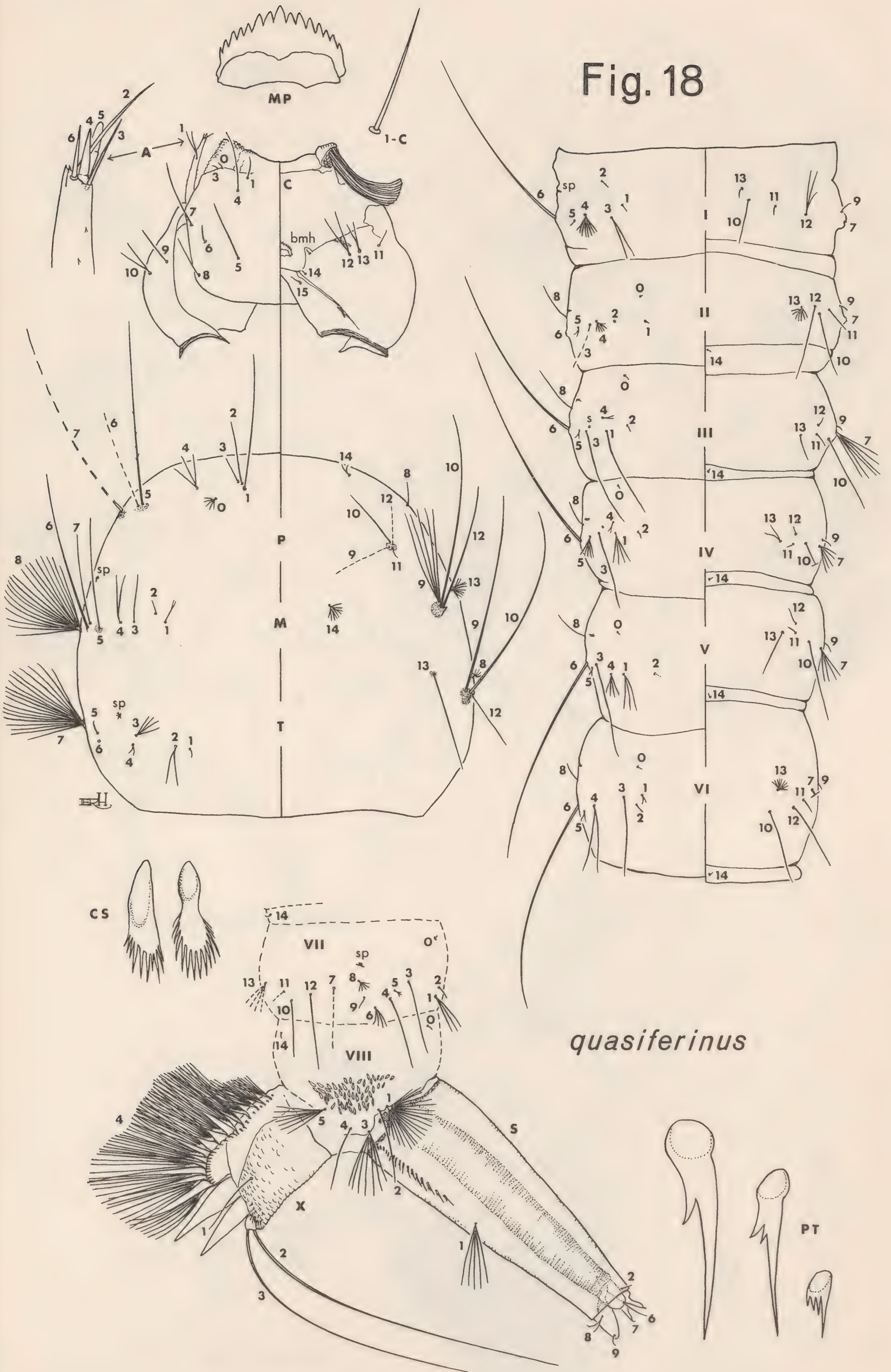
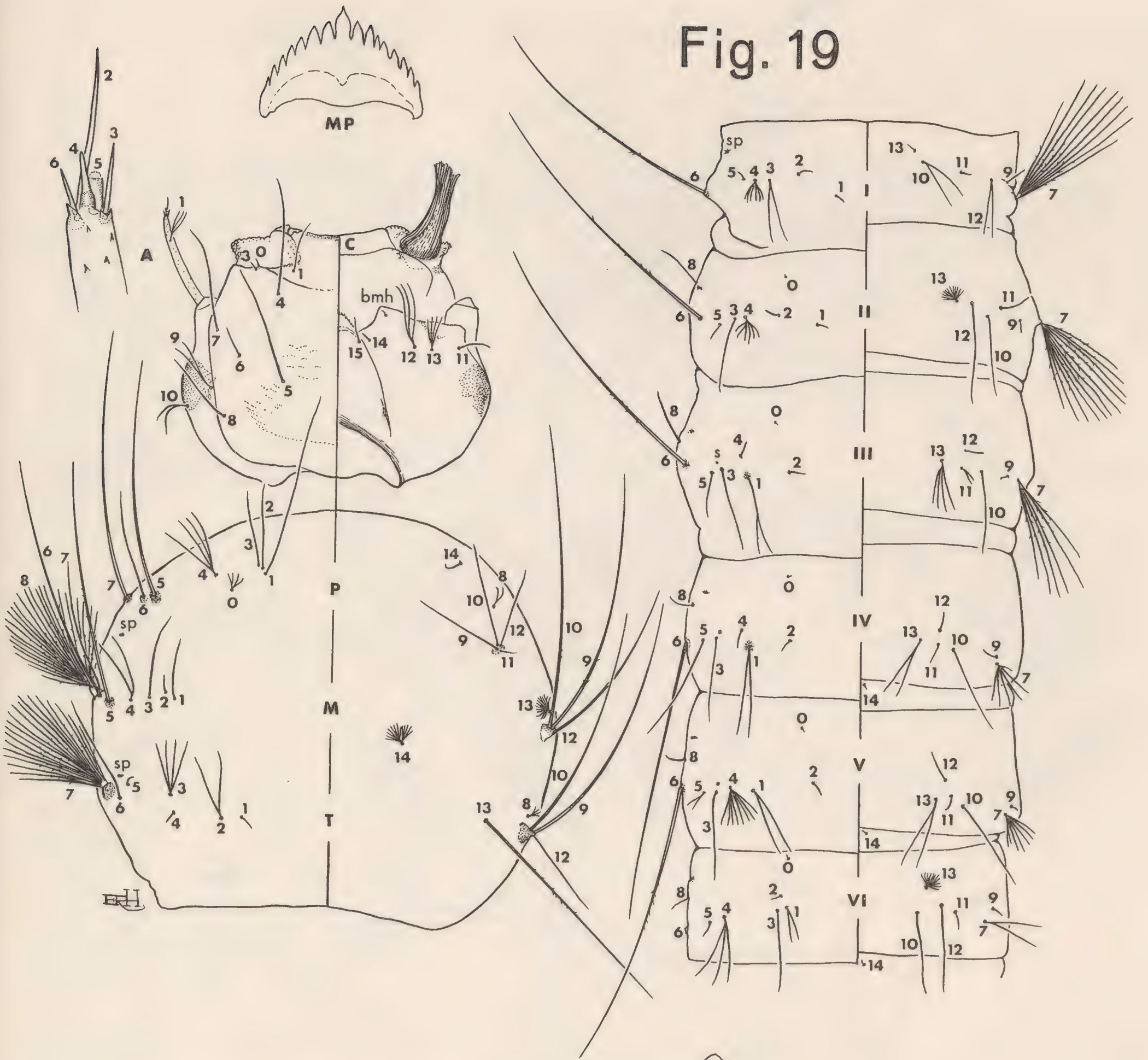




Fig. 20



Fig. 19



*scatophagoides*

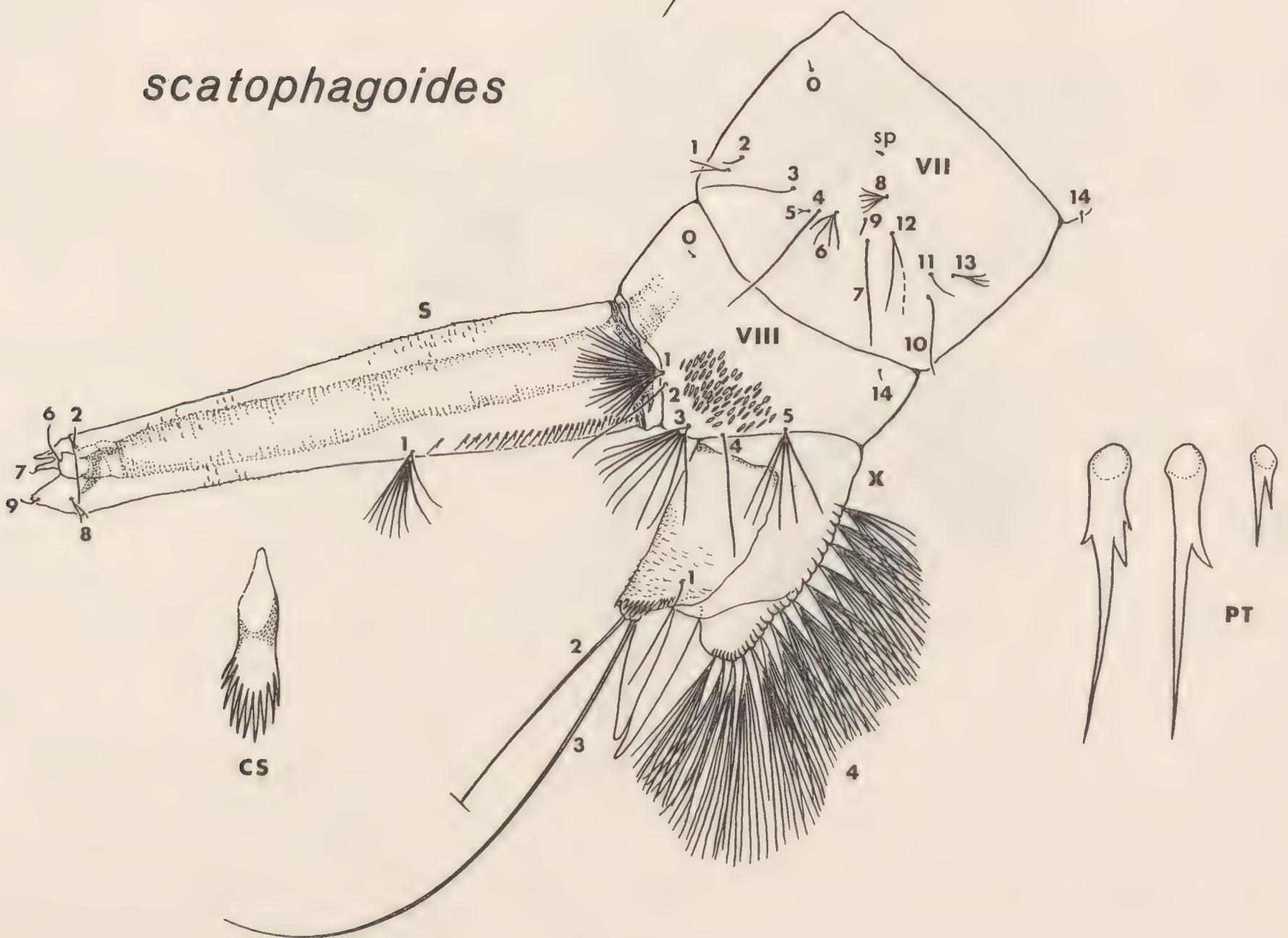
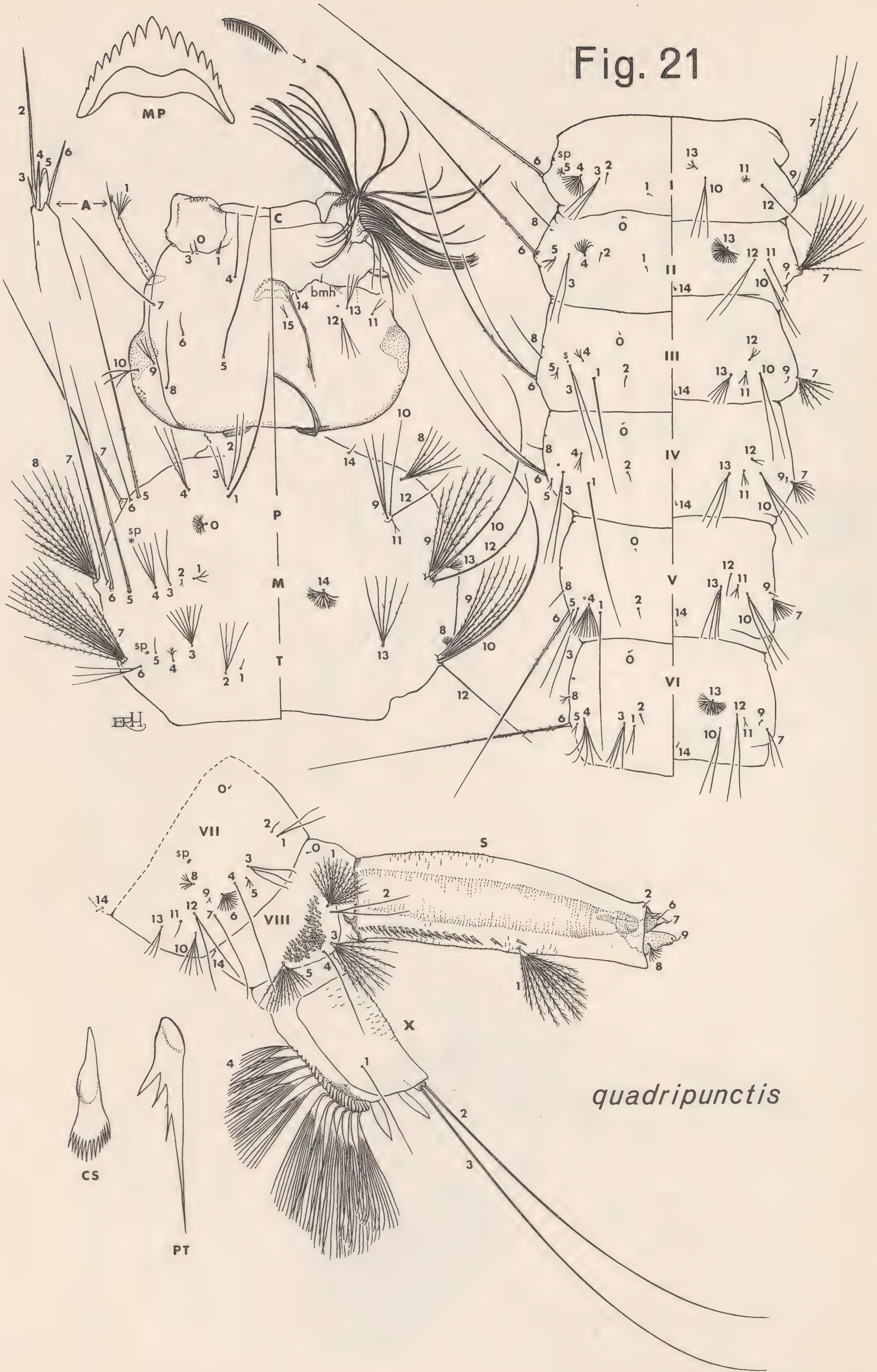


Fig. 21



*quadripunctis*

## INDEX

Valid names are printed in roman type, synonyms are italicized. Italicized page numbers are those which begin the primary treatment of that species. Numbers in parentheses refer to the figures illustrating some portion of that species.

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<i>alternans</i>	29, 31, 33, 34, 43, 45, (6, 7).
<i>annulirostris</i>	34.
<i>annulus</i>	43.
<i>Anopheles</i>	33, 34, 41, 43.
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<i>aurantia</i>	31, 46.
<i>aurantius</i>	29, 33, 34, 35, 36, 37, 46, 48, 49, 50, 57, (6, 7, 9A, 12A, 15B, 20).
<i>aureostriata</i>	29, 31, 46, 48.
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<i>caecus</i>	43.
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<i>Culex</i>	29, 31, 34, 39, 41, 43, 46, 52.
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<i>funereus</i>	34.
<i>gambiae</i>	33.
<i>grahamii</i>	29, 33, 35, (6, 7).
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<i>lucianus</i>	29, 33, 35, (2).
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<i>mucidus</i>	29, 33, 35, (5).
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